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FACTORS CONTRIBUTING TO PERCEIVED EFFICIENCY OF TELEHEALTH CHAT E-CONSULTATIONS

Master's Thesis
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Abstract of master's thesis

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Abstract

The popularity of telehealth e-consultations between a patient and a medical staff member continue to grow while the most recent growth stems from COVID-19 pandemic. The need for telehealth services will most likely increase in the future with the aging population and the expansion of digitalized virtual services for consumers in general. In addition to video and phone mediated e-consultations, chat e-consultations will remain to be a part of this growth. This thesis is conducted as a case study with one case company from Finnish healthcare sector. The case company identified efficiency differences between its different chat e-consultation services. The growth of the e-consultations and the identified efficiency differences together led to further examine the perceived efficiency of chat e-consultations, its challenges, factors causing these challenges and its opportunities. This case study used semi-structured interviews and existing case company documentation in its empirical data gathering. The interview themes centred on e-consultation task requirements, technology, and user capabilities and on their total impacts on perceived efficiency when compared to other consultation forms. These themes were formed by combining Process Virtualization Theory, Task-technology Fit and Media Synchronicity Theory elements.

The results from the study suggest that in chat e-consultations the perceived efficiency seems to depend more heavily on the exact case and especially on patient capabilities, patient commitment and the ailment. Limited sensory information and to some extent the regulation limit the treatable cases in chat e-consultations, and the results suggest that the nurses and the physicians balance their actions according to this limited sensory information. Despite the observation of limited sensory information changing the conversation by increasing the amount of information exchange via text and photos, the results suggest that the more profound factor explaining the challenges in perceived efficiency in chat e-consultations is the asynchrony. According to the results, the user beliefs and associations towards the chat conversations and the lack of chat technology to support synchronicity hamper the perceived efficiency when comparing to other consultation forms. The results show, however, that these factors also provide opportunities that the nurses and the physicians can exploit in order to enhance the chat e-consultation efficiency. Parallel chat conversations, canned messages and sharing links and tables provide a few examples of these chat enabled opportunities. This research provides suggestions for overcoming the current challenges and reaping the benefits of chat e-consultations.

Keywords e-consultation, telehealth, chat consultation, Task-technology Fit, Process Virtualization, Media Synchronicity

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Tiivistelmä

Terveydenhuollon etävastaanotot potilaan ja terveydenhuollon ammattilaisen välillä ovat kasvattaneet suosiotaan. Suosio on lisääntynyt merkittävästi COVID-19 pandemian aikana. Väestön ikääntyminen sekä kuluttajille suunnattujen digitaalisten virtuaalipalveluiden laajentuminen kasvattavat tarvetta etäpalveluille myös tulevaisuudessa. Video- ja puhelinvälitteisten vastaanottojen lisäksi chat etävastaanotot ovat jatkossakin osa tätä kasvua. Tämän tapaustutkimuksen terveydenhuollon yritys havaitsi tehokkuuseroja sen tuottamien chat-etävastaanottojen välillä. Nämä seikat yhdessä johdattivat tutkimaan chat etävastaanottojen koettua tehokkuutta, chatin aiheuttamia haasteita, mistä haasteet johtuvat sekä chatin mahdollisuuksia. Tutkimusdatan keruussa hyödynnettiin puolistrukturoituja haastatteluja sekä yrityksen olemassa olevaa dokumentaatiota tutkimusdatan keruussa. Haastatteluissa teemoina korostuivat chat-etävastaanottotehtävän tarpeet, teknologian ja käyttäjän kyvykkyydet sekä näiden vaikutukset koettuun tehokkuuteen muihin vastaanottomuotoihin verrattuna.

Tutkimuksen tulokset viittaavat siihen, että chat-etävastaanotoissa koettuun tehokkuuteen vaikuttaa tapauskohtaisuus ja etenkin potilaan kyvyt, sitoutuneisuus ja vastaanoton syy. Rajatut aistihavainnot sekä säännökset vaikuttavat siihen, millaisia vaivoja chatissa voidaan hoitaa. Tulokset osoittavatkin, että lääkärit ja hoitajat joutuvat punnitsemaan tarkoin, mitkä vaivat ovat chatin välityksellä hoidettavissa. Vaikka rajoittuneita aistihavaintoja tuetaan lisäämällä viestintää tekstin ja potilaan lähettämien kuvien avulla, tulokset esittävät, että merkittävämmät syyt koetun tehokkuuden haasteisiin ovat kuitenkin muutokset chat-etävastaanoton asynkroniassa. Tulosten mukaan niin käyttäjien tottumukset ja mielleyhtymät chat-keskusteluja kohtaan kuin chat-teknologian kyvyttömyys vaatia synkronista viestintää heikentävät merkittävimmin chat-etävastaanottojen koettua tehokkuutta verrattaessa muihin vastaanottomuotoihin. Tulokset osoittavat, että osittain edellisistä johtuen chat luo myös uusia mahdollisuuksia, joiden avulla lääkärit ja hoitajat voivat parantaa chat-etävastaanottojen tehokkuutta. Useampi samanaikainen chat-etävastaanotto, tallennetut valmisviestit sekä linkkien ja taulukoiden jakaminen toimivat esimerkkeinä chatin mahdollistamista ominaisuuksista. Tutkimus antaa parannusehdotuksia niin nykyisten haasteiden voittamiseksi kuin chatin mahdollistamien ominaisuuksien hyötyjen saavuttamiseksi.

Avainsanat etävastaanotto, etäterveys, chat etävastaanotto, chat

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Definition of terms

Assessment of treatment need – ATN

This task is especially important for occupational nurses in the case company, where they judge whether the patient should be guided for future treatment. Thereby the person performing ATN acts as a sort of a gatekeeper

Consultation

Similar to e-consultation but includes in-person consultations as well

E-consultation

'E-consultations (i.e., technology-mediated expert consultations)' (Serrano and Karahanna 2016, pp. 597) '…refers to the telemedicine consultation session; the consulting expert is the consulting clinician (typically, a physician); and the remote client is a remote patient.' (Serrano and Karahanna 2016, pp. 600) See Figure 1 for more information

Electronic Health Record System - EHR or EHR system

A systematic digital collection of patient health records including patient demographics. In this thesis EHR refers to the Information System that is being used for storing, visiting and editing such records

Medical Staff

A collective term that is used in this thesis to include both physicians and nurses

Media synchronicity

Following Dennis, Fuller and Valacich (2008, pp. 581) 'the extent to which the capabilities of a communication medium enable individuals to achieve synchronicity'

Physician Customership Responsible - PCR

A position in the case company where the person is closely working with the physicians by being responsible for their orientation, supporting with supply and demand balancing regarding physicians and helping the physicians in practicalities.

Task

Following Goodhue and Thompson (1995, pp. 216) 'Tasks are broadly defined as the actions carried out by individuals in turning inputs into outputs.'

Telehealth

Following World Health Organization (2016, pp. 56) 'the delivery of health care services, where patients and providers are separated by distance. Telehealth uses ICT for the exchange of information for the diagnosis and treatment of diseases and injuries, research and evaluation, and for the continuing education of health professionals.'

Telemedicine

Following Telemedicine (2013) in Serrano and Karahanna (2016, pp. 614) '…interactive communication between the patient and clinician that includes both audio and video equipment, at a minimum; as such, with few exceptions'

Virtual process

Following Overby (2008, pp. 278) 'A virtual process is a process in which physical interaction between people and/or objects has been removed.'

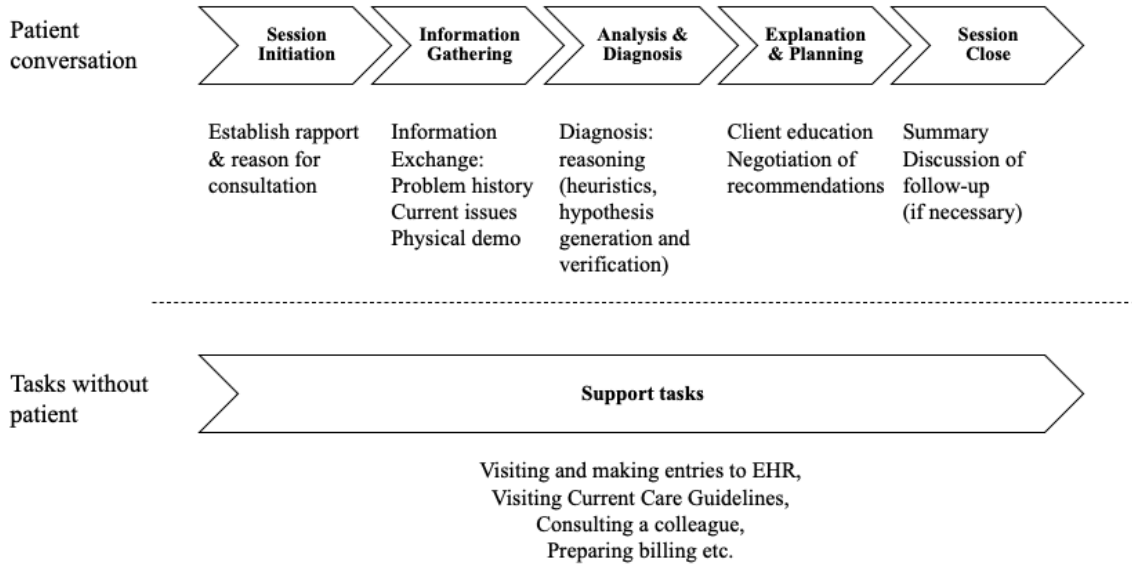

Figure 1. Expert consultation process
Patient conversations part by Serrano and Karahanna (2016)

1. Introduction

This chapter presents the motivation of the research, its research objectives, research question and finally the scope and the structure of the research.

1.1. Motivation

The main benefit of telehealth is its capability to improve access to healthcare by increasing the speed of access and/or reducing the costs related to healthcare access, thus enabling greater equality in health coverage (World Health Organization, 2016). To reach such benefits telehealth needs developing and multiple research domains including Medical, Organizational, and Information Systems research need to be engaged.

Telehealth has existed long before COVID-19 but the pandemic fueled its growth. The initial surge of telehealth usage resulted in close to 80 times higher telehealth utilization for office visits and outpatient care and even after the initial peak the telehealth usage seems to be significantly higher, with 38 times higher utilization compared to pre-pandemic conditions (Bestsennyy *et al.*, 2021). While the level of telehealth usage currently fluctuates, clinical leaders expect virtual visits to find an optimal level that is close to the peak witnessed during the pandemic, which would mean that one-third of all visits would be virtual (Fera *et al.*, 2021). Although the increase in telehealth services might have been fueled due to COVID-19, Smith et al. (2020) argue that the reactive development of telehealth is not enough, but instead requires proactive development for telehealth to be mainstreamed. Indeed, telehealth investments have increased significantly (Bestsennyy *et al.*, 2021) and telehealth strategies are constantly being developed (Fera *et al.*, 2021). The demand is not likely to be lessened in the future either. With the aging population (United Nations, 2019) it is expected that the need for telehealth services will increase and with limited recourses, the services need to be produced effectively and efficiently.

Chat as an e-consultation form provides presumably the lowest threshold service in terms of technological and user capability requirements, and thus has a major potential to expand the universal health coverage. However, the telehealth chat literature is scarce especially regarding the medical staff to patient e-consultations outside the clinical area of mental health.

This research looks into a case of a Finnish healthcare company, where the rise of demand for telehealth services was substantial due to the COVID-19 pandemic. The rapid growth of the telehealth services during 2020 resulted in an over tenfold increase in telehealth consultations provided by the case company and the chat e-consultations played a pivotal role in this change. The case company identified efficiency differences between their rapidly growing telehealth chat services while the factors contributing to this efficiency were unclear.

The growing interest in telehealth services combined with limited healthcare resources calls for efficient telehealth service production. Chat as a low threshold service provides a potentially efficient form for telehealth e-consultations but with limited literature, the factors contributing to efficiency in chat e-consultations need closer examination.

1.2. Research objectives and research question

The study aims to identify how chat e-consultations in telehealth differ from other consultation forms in terms of perceived efficiency and which factors are causing the differences. Thus, the research question is

> *How does the perceived efficiency of chat e-consultations differ from other consultation forms and why?*

Identifying and understanding the factors contributing to chat e-consultation efficiency enable this thesis to provide practical suggestions for the case company and by reflecting these findings to the prior research results and theories, it also provides value for academia. The theoretical part of the study is to first, gather possible factors suggested by prior research, second distinguish relevant Information System theories that provide a solid framework for examining the research question, and finally after analyzing the results scrutinize whether existing literature provides solutions on how to overcome the identified challenges and reap the benefits of the identified opportunities.

The empirical part of the study aims to discover the differences, challenges, and opportunities that chat e-consultations bring. Further, the empirical part will try to identify whether the virtualized consultation, user capabilities, technology capabilities, or some other factors explain the efficiency differences identified by the case company.

1.3. Scope of the study

Telehealth comes in various forms. Figure 2 by Tuckson, Edmunds and Hodgkins (2017) illustrates some of these forms where participating sides, telemedicine tools used, and provided services are presented in a matrix. It is noteworthy that in this thesis the focus is on the medical staff and patient e-consultations that are a part of Clinician to Patient communication in Figure 2. Moreover, the telemedicine tools that are discussed in this thesis cover phone, chat, and video to some degree. In the empirical part of this thesis, the chat e-consultations will be compared to phone and in-person consultations. Thus, in this thesis, the Home Online Health Consultation definition by Almathami, Than Win and Vlahu-Gjorgievska (2020) will be followed where the more asynchronous media such as e-mail will be excluded.

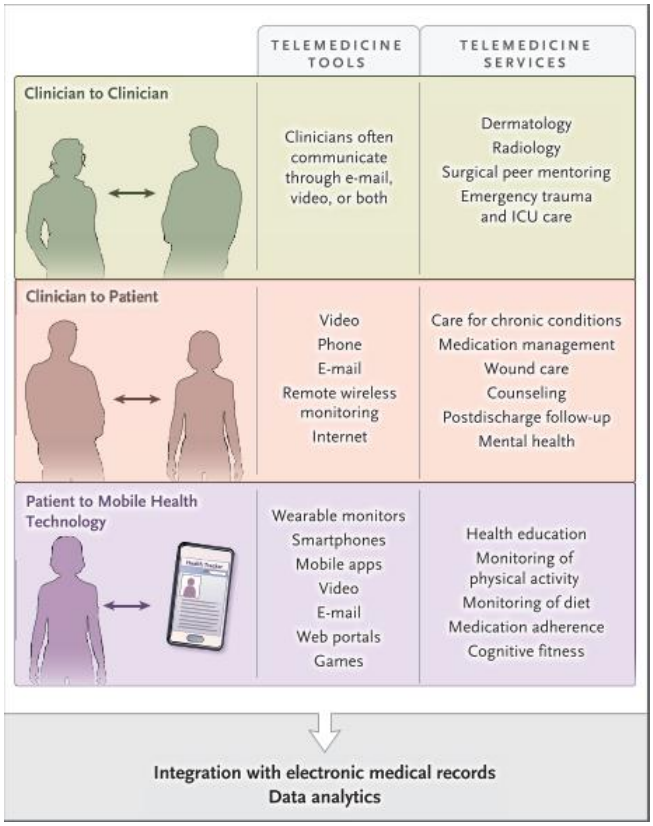

Figure 2. How doctors use telemedicine and how patients benefit
Source: Tuckson, Edmunds and Hodgkins (2017)

This thesis is provider-side driven and reflects the patient perspective only via medical staff perceptions. The patient side perceived efficiency, experiences and challenges have to be

ruled out due to the scope of the thesis despite the utmost interest these patient side insights would bring to this dyadic e-consultation. Moreover, the thesis focuses on primary care e-consultations, which include a wide spectrum of ailments and reasons for care.

1.4. Structure of the thesis

This research consists of six chapters. The first chapter introduced the research by describing the research motivation, research objectives, and research question after which the scope of the study was clarified. The second chapter includes the theoretical background of the study. The third chapter describes the methodology of the research. The empirical results of the research will be presented in Chapter 4 and these results will be followed by the discussion in Chapter 5. Finally, Chapter 6 concludes the research.

2. Theoretical background

This chapter examines the theoretical background for the research. The telehealth section provides context-related information, Process Virtualization Theory suggests a framework for analyzing the change from non-virtual to virtual process. Task-Technology Fit Theory is used to focus on the interplay between technology capabilities, user capabilities, and the task requirements, and how this interplay affects task performance. Media Synchronicity Theory provides factors for examining the characteristics of chat as a medium more specifically, thereby deepening understanding of its technological capabilities.

2.1. Telehealth

This section focuses on telehealth, its benefits, and its challenges. First, an overview of telehealth will be presented with the current benefits and challenges related to it. These will be presented from governmental and societal, patient, and medical staff perspectives. Second, findings regarding telehealth effectiveness will be gathered. Third, the focus will be on the telehealth e-consultations and finally on existing literature on chat usage in the telehealth context.

2.1.1. Telehealth adoption, benefits, and barriers

Regarding societal benefits, telehealth contributes to achieving universal health coverage, by enhancing access for patients to quality and cost-effective health services, which is especially valuable for aging populations, vulnerable groups, and those living in remote areas (World Health Organization, 2016). World Health Organization (2016) reported that more than half of responded Member States (57%, n =70) had either a specific national telehealth policy or that telehealth was referenced within their national eHealth policy. However, telehealth adoption does not come without barriers. From the governmental perspective, the most important impediments were a lack of funding to develop and support telehealth programs, a lack of infrastructure (such as connectivity or equipment), competing system priorities, and a lack of legislation or regulations covering telehealth programs (World Health Organization, 2016).

The national and global level spread of telehealth cannot be achieved without individual benefits. Regarding patient benefits of Home Online Health Consultations, Almathami, Than Win, and Vlahu-Gjorgievska (2020) list convenience, reliability, health care availability, and cost savings as the most important internal patient benefits. Reducing patient and family travel burdens, filling the gaps in care, providing access to services outside normal clinic hours, facilitating appointment scheduling, and refilling prescription services (Tuckson, Edmunds and Hodgkins, 2017) are some embodiments of these benefits. Thus, regardless of the service or form of telehealthcare provided, convenience, time-saving, and flexibility seem to form the essence of the individual benefits and thus ease the spread of telehealth. Furthermore, consumers have an active role in spreading telehealth. Tuckson, Edmunds and Hodgkins (2017) provide multiple examples of health systems where telehealth interventions are used to respond to consumer expectations and business challenges, which highlights that healthcare among other industries is constantly influenced by changes in consumer technology markets.

Regarding the patient barriers and acceptance of telehealth, Serrano and Karahanna (2009) find a relative advantage, informational influences, and relationship with one's physician as the most important predictors of telehealth acceptance. A systematic review by Scott Kruse *et al.* (2018) finds the age of the patient, level of education, computer literacy, bandwidth, and unawareness as the most frequent patient-side barriers for telehealth worldwide adoption. Almathami, Than Win and Vlahu-Gjorgievska (2020) support those findings in

terms of connection issues, resistance and system use difficulties and add patient communication skills such as limited body language, patients' perceptions of security and privacy, and finally home obstructions as patient-side barriers for adoption. Almathami, Than Win and Vlahu-Gjorgievska (2020) suggest resistance, clinical and patient communication skills such as limited body language, patients' perceptions of security and privacy as internal barriers and system use difficulties, connection issues, lack of organizational support regarding policies, law, and reimbursements and finally home obstructions as external barriers for Home Online Health Consultations. Moreover, existent literature has noticed that even though telehealth may improve access for many as more and more patients get access to broadband internet access and smartphones, due to the digital divide, such access is not distributed evenly. Thus, connectivity barriers may emerge for low-income, minority, rural and elderly patients (Fortney *et al.*, 2011).

Medical staff is naturally in a pivotal role in determining telehealth spread. Scott Kruse *et al.* (2018) find technically-challenged staff, resistance to change, perception of impersonal care, and info overload as medical-staff side acceptance barriers. Furthermore, Scott Kruse *et al.* (2018) discovered that another acceptance barrier to medical staff was state-licensing limitations in the US and Canada that prevented medical staff to provide their services across state borders. In addition to its frequency, this discovery is important since it couples governmental policies and legislation to individual adoption barriers. More medical staff barriers and challenges will be discussed in Section 2.1.4.

Healthcare professionals have a key role regarding telehealth spread but they face a difficult task. Health professionals need to 'adapt to innovations in consumer technologies, integrate these solutions into clinical workflow, seek evidence-based guidance for decision making, and manage the evolving relationships between care teams and their patients' (Tuckson, Edmunds and Hodgkins 2017, pp. 1590-1591) and thus they require evidence to support their decision making with and on behalf of their patients (Tuckson, Edmunds and Hodgkins, 2017). Results by (Hu *et al.*, 1999) suggest that the perceived usefulness of telemedicine technology affects the physician's attitude and intention of usage but the perceived ease of use lacks support. Scott Kruse et al. (2018) add that the most prominent barriers are technology-specific and with the help of training, change-management techniques, and focused policy they could be overcome.

2.1.2. Effectiveness

Telehealth literature is vast and suggests telehealth being more effective in certain clinical focus areas and functions of care delivery. Over 200 systematic reviews and hundreds of primary published studies since 2006 regarding telehealth effectiveness (Totten *et al.*, 2016) highlight the enormous evidence base. Totten *et al.* (2016) summarize that the majority of the research papers included in their paper concluded that telehealth has positive results in interventions regarding chronic conditions and behavioral health or when used for counseling or communication and monitoring or management. Such findings are supported by Scott Kruse *et al.* (2018) as they conclude that telemedicine efficiency in reaching patient populations has been proven in multiple countries regarding telemetry, mental health, and diabetes management. Results from Roine, Ohinmaa and Hailey (2001) find evidence for effectiveness for the use of electronic referrals enabling email consultations and video conferencing between healthcare providers, regarding the functions and for instance teleradiology, teleneurosurgery, and telepsychiatry regarding the clinical areas.

Responding national programs follow suit as World Health Organization (2016) reported that out of the responding countries in 2015 survey three quarters having a teleradiology program, roughly half a telepathology program, a remote patient monitoring program and teledermatology program, and one third having a telepsychiatry program. It is noteworthy that all of these shares are higher than in the 2010 survey as Figure 3 by World Health Organization (2016) illustrates. The shares are calculated based on the number of countries that responded to both surveys.

Regarding home telehealth Bensink, Hailey and Wootton (2006, 2007) find evidence for diabetes, high-risk pregnancy monitoring, heart failure, and cardiac diseases, and even stronger evidence for the general area of mental health and smoking cessation.

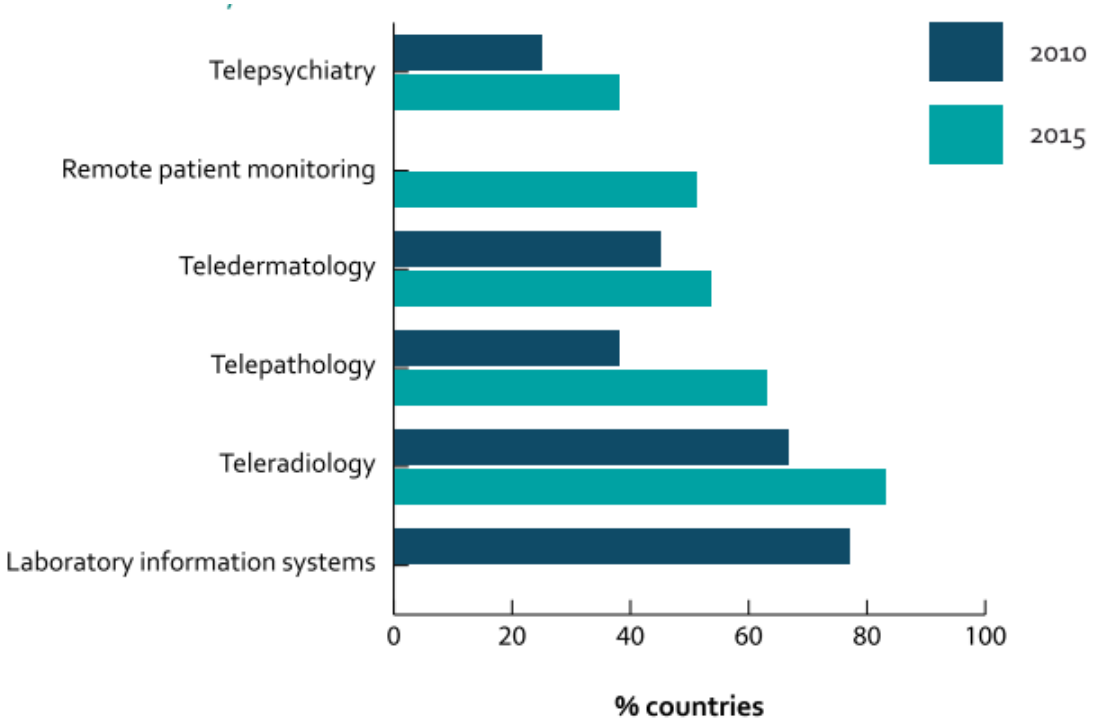

Figure 3. Number of countries reporting a telehealth program in the 2010 and 2015 surveys
Source: World Health Organization (2016)

Totten *et al.* (2016) find that results considering telehealth cost-effectiveness also vary in terms of clinical focus and telehealth function as shown in Table 1. They conclude that more research on telehealth cost-effectiveness is needed on multiple clinical focuses and telehealth functions. More generally, there is a need for studies examining overall costs-impacts with more comprehensive economic analysis including sensitivity analysis (Roine, Ohinmaa and Hailey, 2001; Whitten *et al.*, 2002), instead of measuring only individual costs or using isolated resource use measurements (Totten *et al.*, 2016).

Thus, it seems that despite the growing interest towards telehealth cost reduction potential, the traditional role of telehealth as a tool to improve access to services (United States Senate Committee on Finance, 2015) is holding its ground. It seems that existing literature does not deny telehealth cost-effectiveness, but rather calls for more profound analysis. Therefore, it is safe to summarize that no general cost-effectiveness of telehealth interventions can be assumed even if there are multiple studies suggesting benefits or potential benefits on certain clinical focus areas and telehealth functions.

	Communication and Counseling	Remote Patient Monitoring	Multiple Functions	Psychotherapy	Consultation	Telerehabilitation	Telementoring
Mixed Chronic Condition	15 studies[46]	24 studies[52] 9 studies[68]	10 studies[49] 21 studies[50]	None	None	None	None
Cardiovascular Disease	None	12 studies[73] 9 studies[45] 11 studies[42] 4 studies[41]	None	--	None	None	None
Diabetes	35 studies[80]	None	None	--	None	None	None
Behavioral Health	None	None	None	12 studies[65]	None	--	None
Mixed	15 studies[59] 5 studies[38] 31 studies[56]	None	36 studies[78]	None	None	None	None
Physical Rehabilitation	None	None	None	--	None	28 studies[57] 27 studies[54]	None
Respiratory Disease	None	7 studies[58] 23 studies[55] 10 studies[66]	7 studies[44]	None	None	None	None
ICU/Surgery Support	None	1 study[75]	None	--	8 studies[61]	None	None
Burn Care	None	None	None	None	24 studies[79]	None	None
Preterm Birth	None	15 studies[77]	None	None	None	None	None

ICU=intensive care unit
Note: Study counts given reflect the total number of studies included in the review, including studies that did not analyze cost.
Legend: Benefit; Potential Benefit; Unclear; No Benefit

Table 1. Evidence on cost and utilization from systematic reviews: the intersection between clinical focus and telehealth function

Source: (Totten et al., 2016)

2.1.3. Trends

Dorsey and Topol (2016) discuss three trends affecting telehealth: transformation from increasing access to healthcare providing convenience and reducing costs, expansion from addressing acute conditions to addressing episodic and chronic conditions as well, and finally the migration to home and mobile devices. These indeed are currently ongoing as presented above. Tuckson, Edmunds and Hodgkins (2017, pp. 1586) instead gather five telehealth related trends from existing literature that can fuel the telehealth adoption into the delivery of clinical care in the future: 1) 'Continuous innovation in the consumer technology market' 2) 'Continuous advancement in electronic health records and clinical-decision support systems' 3) 'Projected shortages in the health professional workforce' 4) 'Reorganization in the delivery and financing of medical care … toward value-based reimbursement,' 5) 'Growth of consumerism in health care.' They continue, however, that how these trends will unfold, depends on the evolving business and policy contexts and lift integration of telehealth data into Electronic Medical Record (EMR) systems and the spread

of value-based reimbursement formulas essential in this respect (Tuckson, Edmunds and Hodgkins, 2017).

2.1.4. Telehealth and e-consultations

As shown in Figure 2 there are multiple communication tools used for care provider-patient consultations, and telehealth communication in general, thanks to telehealth technology (Fortney *et al.*, 2011; Tuckson, Edmunds and Hodgkins, 2017). For instance, Serrano and Karahanna (2016), Cady and Finkelstein (2014) examine video and telephone mediated session differences between patient and care provider while Li, Rai and Ganapathy (2020) focus on assisted video sessions where an on-site operator is helping the patient with both technical issues as well-performing physical evaluations and measurements. However, when compared to other mediums chat mediated telemedicine e-consultation literature is scarce and findings regarding chat in telehealth literature will be discussed in the next section more specifically.

Although examples such as Almathami, Than Win and Vlahu-Gjorgievska (2020) exist that suggest video conferencing effectiveness and patient acceptance due to its ability to simulate face-to-face consultation, telecommunication in the telehealth context is not unproblematic. Although referring to clinician-to-clinician remote consultations Lehoux *et al.* (2002) argue that telemedicine did not fit into clinicians' consultation and referral communication routines. Even in interactive video consultations the patients and clinicians can use only audio and video channels for communication only. Compared to in-person consultations this limited symbol set available lacks physical contact and nonverbal cues, which according to Miller (2001, 2003) as cited by Serrano and Karahanna (2016), may potentially decrease the quality of exchanged information and thus impact the result of the consultation.

Brant *et al.* (2016) find prevalence for telephone consultations but reluctance among general practitioners to start using email or video consultations instead of face-to-face consultations. They list increased workload, increased clinical risk, challenges of technology, and disadvantages for some patient groups as examples of concerns. E-consultations bring technological challenges as well. Among other identified challenges Wootton *et al.* (2020) list device and connectivity issues by both the patient and the clinician, audio and video transmission and synching issues as well as session initiation issues as frequently occurred technology-related challenges in their study. Serrano and Karahanna (2016) recognize the

limitations of communication technology in e-consultations but highlight the compensatory capabilities of users for adapting to the limitations. Moreover, Wootton *et al.* (2020) conclude that major improvements in video-based counseling services can be achieved even with minor technological modifications regarding the preparation and provision of services. Hence, it seems that technological challenges can often be overcome but communication barriers between the client and consultant can be more difficult to defeat in this dyadic relationship.

In their triage nurse workflow analysis Cady and Finkelstein (2013) found that despite occurred connectivity issues disrupting triage workflow or added interactions and activities, video telehealth was consistently rated useful by the nurses even if it required significantly more time than telephone triage. Based on their interpretive analysis of the qualitative and quantitative data, they interpret that even though video triage reduces triage nurse efficiency, video triage alters the assessment triage nurses provide to physicians by increasing the depth and breadth of data available in video (Cady and Finkelstein, 2013). Although the impact on the total efficiency of the clinic remains unknown, their study suggests that the most simple measures such as time consumed per triage or e-consultation are not adequate measures to cover the multidimensional impacts that the change of medium may cause as a whole.

2.1.5. Chat in telehealth

Chat usage in telehealth yields results from different clinical areas and in different types of use cases, but the extant literature seems to lack a comprehensive and holistic systematic literature review on chat usage in telehealth.

Mixed results and interpretations of chat efficiency, effectivity, and usefulness exist. Eminovic et al. (2004) found that in the trial of using chat as a communication medium for nurse-led triage duration of chat sessions doubled compared to phone sessions and thus was too expensive in that use-case. However, the patients valued the chat service and its capability to enable re-reading the messages after the session and saw the chat as a useful addition to regular care but not as a replacement (Eminovic *et al.*, 2004). Gieselmann and Pietrowsky (2019) find that the results from chat-based psychotherapy patients in insomnia treatment outperformed face-to-face patients slightly. Moreover, chat enhances access to healthcare for patients in specific patient groups, such as the deaf, shy, or socially isolated, or for patients who are not capable or willing to attend to face-to-face treatment for other reasons (Eminovic *et al.*, 2004; Gieselmann and Pietrowsky, 2019). Dowling and Rickwood

(2015) list multiple examples of research papers suggesting chat effectiveness as a treatment modality for treating mental health issues such as anxiety, depression, and various social and emotional problems. However, the results for the effectiveness of chat as a treatment modality vary significantly, and thus when compared to phone counseling, problem-solving processes in chat have been found in previous literature to be more effective, as effective, and less effecting (Dowling and Rickwood, 2015).

A chat-based conversation may impact the dynamic and feel of the communication. Regarding the dynamic of the chat conversation, Mallen *et al.* (2011) found that in online counseling participants used twice as much open questions and reassurance while skimping on interpretations and direct guidance. The participants felt increased distance from the client but to a degree denying therapeutic alliance increase after the online session (Mallen *et al.*, 2011). Regarding the patient perceptions, chat-based communication was seen as more direct, clearer, practical, and less complex when compared to face-to-face, and to some degree chat increased privacy and helped the patients to stick to thoughts (Gieselmann *et al.*, 2021). Some patients were dissatisfied due to low communication speed and too simple communication that may induce difficulties in expressing oneself and thus create a possibility for misunderstandings (Gieselmann *et al.*, 2021).

As will be discussed later, the asynchronous nature of the chat e-consultation process differs from both traditional physical consultations as well as e-consultations via video or phone. However, in terms of existing telemedicine literature, the chat-mediated live e-consultation that is in focus in this thesis could be seen more on the synchronous side of the spectrum. E.g. Edison *et al.* (2008) use the triad 'live-interactive', 'in-person', and 'store-and-forward' to cover the different forms of examinations. From this perspective, chat belongs to the 'live-interactive' category similarly to phone and video-mediated examinations, whereas the store-and-forward represents the asynchronous side. Thus, both asynchronous and synchronous processes exist in the telemedicine domain. According to the World Health Organization (2016) out of the two, asynchronous telehealth requires less-costly infrastructure and is easier to organize, which could partly explain the popularity of asynchronous teleradiology and teledermatology programs in telehealth.

2.2. Process Virtualization

This section summarizes the key elements of Process Virtualization Theory and their impacts on process virtualizability.

2.2.1. Overview

Overby (2008) recognizes that our society is becoming more virtual and traditional processes built on physical mechanisms are being virtualized. Scholars often use the term 'virtual' to describe the lack of physical interaction (Fiol and O'Connor, 2005). Process virtualization-related topics were earlier fragmented across different domains such as shopping, medicine, education, banking, and relationship development, therefore, lacking more generalized theory for this increasing phenomenon (Overby, 2008; Overby, Slaughter and Konsynski, 2010). In essence, Process Virtualization Theory (PVT) by Overby (2008) answers two questions: what factors affect the 'virtualizability' of a process and what kind of a role IT has in this virtualization. Even though IT is a central part of PVT in Overby's (2008) framework, he recognizes that processes can be virtualized without IT and offers catalog sales as an example.

PVT (Overby, 2008) identifies sensory, relationship, synchronism, and identification and control requirements as the key factors and main constructs that affect the virtualizability of the process. More specifically, the higher the requirement, the less amenable the process is to virtualization (Overby, 2008). These main constructs are accompanied by three characteristics of IT that impact process virtualization as moderating constructs: representation, reach, and monitoring capability (Overby, 2008). Figure 4 illustrates the theoretical model of PVT.

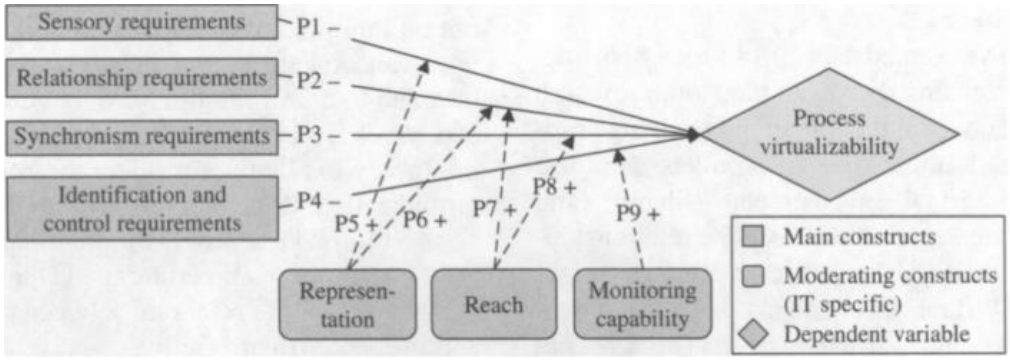

Figure 4. Theoretical Model of Process Virtualization Theory
Source: Overby (2008)

Overby (2008) crystallizes that process virtualizability is not a binary value, but a continuous one and should be thought of as a degree. Thus, if some requirements are seen high and the current implementation of the already virtualized process does not fulfill the requirement, intuitively one could deduce that such high requirements may propose a threat for virtualized process effectivity. The process as a whole and its virtualizability can indeed be seen as a question of degree, but slicing the process into parts, tasks, enables even greater flexibility for virtualization. Overby, Slaughter and Konsynski (2010) point out that some process parts, or tasks, can be virtualized while other tasks - not so amenable for virtualization - can be left unvirtualized therefore forming a 'hybrid' processes. They add that Task-Technology-fit, which will be discussed in Section 2.3, could be used for assessing which tasks of the process should be virtualized and which not.

PVT provides a framework that can and is used in many research settings. These include using PVT for assessing the change from physical to virtual process in telecommunication markets (Czarnecki, Winkelmann and Spiliopoulou, 2010) and examining the user-perspective reasons for using or rejecting virtual processes e.g. in the banking sector (Barth and Veit, 2011; Balci, Grgecic and Rosenkranz, 2013). PVT has also been used as a part of the research model or the conceptual framework of the research in telehealth (Serrano and Karahanna, 2016), and in Green IT adoption (Thomas, Costa and Oliveira, 2016).

2.2.2. Main constructs

Main constructs in PVT are formed by sensory, relationship, synchronism, and identification and control requirements. Overby (2008, pp. 280) describes sensory requirement as 'the need for process participants to be able to enjoy a full sensory experience of the process and the other process participants and objects. Sensory experiences include tasting, seeing, hearing, smelling, and touching other process participants or objects, as well as the overall sensation that participants feel when engaging in a process, e.g., excitement, vulnerability, etc.'. Again, processes, where sensory requirements are high processes are less virtualizable. This requirement can propose a serious challenge for virtualization since modern IT with its representation capabilities, is limited to hearing and seeing (Overby, 2008). While the more physical sensory experiences may be easier to understand and limit, the overall sensations leave more room for interpretation. To gain a more complete understanding regarding these sensory requirements, Barth and Veit (2011) in their Extended Process Virtualization Theory research model use perceived need for consultation within the consultation and perceived

process involvement as predecessors of perceived sensory requirements and find statistically significant support for these user-perceived factors in explaining resistance towards conducting processes virtually. The sensory requirement is also seen important in the telehealth context as Serrano and Karahanna (2016) link sensory requirement as a task requirement in their e-consultation related research. Balci, Grgecic and Rosenkranz (2013) found support for higher perceived sensory requirements being linked to stronger user resistance and lower perceived process virtualizability in online banking.

Overby (2008, pp. 281) defines relationship requirement as 'the need for process participants to interact with one another in a social or professional context. Such interaction often leads to knowledge acquisition, trust, and friendship development'. According to Overby (2008), many studies in IS literature have studied this relationship forming via virtual communication media and have leaned on Media Richness Theory by Daft and Lengel (1986). Overby and Konsynski (2008) provide examples of virtualized processes where the relationship requirement has been high, but based on earlier literature they conclude that in such situations the relationships developed tend to be weaker than in corresponding physical environments. Serrano and Karahanna (2016) conclude that rapport and trust are in a central role in successful information exchange between the patient and the consultant in telehealth. Thus, they include trust as a task requirement derived from this relationship requirement in PVT. Higher relationship requirement is perceived to increase user resistance for virtualized processes (Barth and Veit, 2011; Balci, Grgecic and Rosenkranz, 2013), but its effects on process virtualizability (Balci, Grgecic and Rosenkranz, 2013) or perceived Task-Technology-Fit in the PVT-TFT integrated model (Overby and Konsynski, 2010) are not found significant.

Synchronism requirement defined by Overby (2008, pp. 281-282) as the 'degree to which the activities that make up a process need to occur with minimal delay', forms the third main construct in PVT. Overby (2008) clarifies that physical processes tend to be synchronous by their nature as the process participants often interact with minimal delay. Synchronism requirement e.g. in the wholesale automotive market context would describe the need of the buyer for immediacy in completing administrative tasks and taking ownership of the purchased vehicle (Overby and Konsynski, 2008). The negative effect of higher synchronism requirement on process virtualizability (see P3 in Figure 4) is supported by literature (Overby and Konsynski, 2008; Barth and Veit, 2011; Balci, Grgecic and

Rosenkranz, 2013). Support is also found between higher synchronism requirement and higher resistance for virtualized process use (Barth and Veit, 2011; Balci, Grgecic and Rosenkranz, 2013).

The fourth main construct of PVT is identification and control requirement defined as 'the degree to which the process requires unique identification of process participants and the ability to exert control over/ influence their behavior' (Overby 2008, pp. 282). The banking and healthcare sectors provide fruitful examples where one might expect identification requirements to be high since knowing or verifying the other participant in high confidential information exchange is emphasized. Balci, Grgecic and Rosenkranz's (2013) research supports this as they find higher perceived identification and control requirement decreasing perceived process virtualizability and increasing user resistance in online banking. Overby and Konsynski (2008) find conflicting results in the first empirical test of PVT but remind the importance of identification and control requirement in general PVT framework even though they did not find support for their hypothesis regarding this requirement in that specific context.

However, it is important to notice that the requirements are not constant within the process but may fluctuate either between the repetitions of the process or even between the different parts of the process (Overby and Konsynski, 2010). E.g. in the telehealth context, Serrano and Karahanna (2016) describe that e-consultations vary in their need for sensory information. Reasons for this variation are many, for instance in the telehealth context different symptoms may require analysis with sensory information that is beyond the reach of the representation capabilities of IT while other symptoms and their analysis can be handled with auditorial and visual cues only.

2.2.3. Moderating constructs

According to Overby (2008), IT has had a major impact on process virtualization and thus it is important to shed light on the mechanisms of how IT affects process virtualization. Overby (2008) identifies three IT characteristics - representation, reach, and monitoring capabilities - as IT-specific moderating constructs. As Figure 4 by Overby (2008) shows, PVT proposes that these moderating constructs have a positive effect on process virtualizability. These IT-technology-specific characteristics sort of describe not only how IT tries to meet the requirements of the process but also to boost the benefits of virtualizing it. Thus, it is expected in this IT-enabled e-consultation process that they play a pivotal role

regarding the 'fit' of the technology. That is why these moderating constructs will be examined more thoroughly in Section 2.3 regarding Task-Technology-Fit.

Representation stands for the ability of IT to present relevant information for the process such as simulations and characteristics of actors and objects in the physical world (Overby, 2008). Overby and Konsynski (2008) find that in the wholesale automotive market representation capabilities of the technology can positively moderate process virtualizability via meeting the sensory requirements to some extent. Zooming out from the PVT framework, the definition for representation given by Overby (2008) shares the fundamental idea of presenting parts of the world to the IS user, by Burton-Jones and Grange (2013) as they discuss effective usage of IT from the representation theory perspective. The existence of representation theory shows that representation even as a stand-alone element forms a vast whole.

This representation is lifted as the only technology capability in Serrano and Karahanna's (2016) research, which highlights the proposed link from representation to sensory requirements as seen in Figure 4. As Overby (2008) acknowledges, the representational capabilities of IT with simulations, for instance, may even exceed the capabilities of physical objects themselves. However, regarding telehealth and e-consultation context, representation is examined mainly as a potential limitation to diagnosticity as in Edison *et al.* (2008) and Serrano and Karahanna (2016) as mentioned above along with sensory requirements. In addition to higher representation capabilities having a positive impact on process virtualizability regarding sensory requirements, PVT also proposes higher representation capabilities having a positive impact on process virtualizability regarding relationship requirements (Overby, 2008) as seen in Figure 4. Thus, it suggests that in the e-consultation context, it may affect trust-building between the participants.

Reach as a moderating construct on the other hand has a slightly different effect on the main constructs. As Overby (2008, pp. 283) proposes, this 'IT's capacity to allow process participation across both time and space' impacts positively on process virtualization regarding both, relationship and synchronicity requirements. Overby and Konsynski (2008) studied the relationship between relationship requirement and reach capabilities of the technology and found support for the positive moderating effect on electronic market usage. While the interpretation of the effect on relationship requirement in our chat-mediated e-consultation context is somewhat fuzzy, the effect that the reach has on the synchronicity is

indisputable. For instance, due to the reach of IS, clinicians can offer their services to patients in sync from all around the world. From this perspective, the reach construct reaps the benefits of IS usage as opposed to merely meeting the requirements as in the representation construct.

The third moderating construct is the monitoring capability that entails the process participant authentication and activity tracking capabilities of IT (Overby, 2008). Overby (2008) proposes that identification and control requirement and monitoring capability are positively linked as seen in Figure 4. Similar to the reasoning regarding IT-enabled reach benefits, Overby (2008) points out that monitoring capabilities in IT-based virtual processes may exceed the capabilities in physical processes. Saved conversation history and the exact timestamps of starting and ending the consultations are practical examples of better activity tracking between the IS-based virtual and non-virtual processes in telemedicine. This enhanced activity tracking may prove to be useful also from the manager's perspective. Furthermore, it may even challenge the status quo on how to define and measure performance and its goals.

Overby (2008) does not identify the linkage between monitoring capability and relationship requirement although one might expect that the monitoring capability via authentication possibilities would affect trust-building between the participants. Perhaps this monitoring capability could be seen indirectly affecting relationship requirements since the identification and control requirements catch this effect. Only then together this monitoring capability with the identification and control requirements moderate the relation between relationship requirement and process virtualizability.

2.3. Task-technology-fit

In the next section, the technology, task and its requirements and perceived effectiveness will be examined from the Task-Technology-fit theory perspective. The Task-Technology-fit theory will be examined. The focal task of telehealth chat e-consultation will be reflected throughout the section.

2.3.1. Overview

Goodhue and Thompson (1995, pp. 216) encapsulate Task-Technology Fit (TTF) as 'the degree to which a technology assists an individual in performing his or her portfolio of tasks'. More specifically they identify that technology must be utilized and it must be a good fit with the task in order to information systems having a positive impact on individual performance (Goodhue and Thompson, 1995). This linkage between individual, task, technology, and performance is created by the 'Technology-to-Performance chain' (TPC) (Goodhue and Thompson, 1995). The widely used TTF model was built on synthesizing two research streams 'utilization focused' and 'fit focused' (Goodhue and Thompson, 1995). Figure 5 presents this combined chain. In extant primary TTF research, the quantitative methods are more often used but examples from the qualitative approach exist as well (Cane and McCarthy, 2009). Task-Technology fit framework has been used for many research fields, but regarding the intersection of Health and Information Systems research Task-Technology fit framework is pivotal in the following papers. Ali *et al.* (2018) use TTF for analyzing electronic patient portal for patient work, Cady and Finkelstein (2014) examine advanced practice registered nurse care coordination workflow via video and via telephone with the help of TTF, and finally both Serrano and Karahanna (2016) and Mburu and Oboko (2018) base their research on TTF framework where the task or process requirements have been derived from Process Virtualization Theory. The former of the last two focuses on compensatory capabilities between user and technology, and the latter composes a model for predicting utilization of mHealth interventions.

Utilization research stream that gained more attention before TTF model, examines user attitudes and beliefs as the predictors of IS utilization in TPC (Goodhue and Thompson, 1995). At a glance, TTF seems to have convergences with the widely known Technology Acceptance Model (TAM). However, as Goodhue, Klein and March (2000) describe, the TAM focuses on predicting technology usage rather than its impact on individual performance, which separates fundamentally these two theories. Cane and McCarthy (2009) continue that the TAM focuses on intention to use whereas the TTF focuses on actual utilization. These theories have been used to complement each other in various studies (Cane and McCarthy, 2009). Still many papers using the TTF framework focus on the utilization perspective rather than on fit-generated performance (Cane and McCarthy, 2009) and the paper by Mburu and Oboko (2018) provides an example. However, as Goodhue and

Thompson (1995) acknowledge, utilization may not always stem from system quality, the usefulness of systems, or user attitudes as usage may be mandatory or heavily dependent on external motivators. Hence, the importance of Fit-stream is emphasized in impacting the performance. Figure 5 by Goodhue and Thompson (1995) gathers together the entire TPC from precursors to feedback. The fit focus is interested in the interplay of task, technology and individual characteristics and Figure 5 visualizes this interest. Given the problematic challenges regarding utilization, the fit perspective will be the main approach in this thesis.

Furthermore, the multiple regression analysis results from Goodhue and Thompson (1995) suggest that fit does not directly predict utilization, but would require a more thorough analysis. The model used for their research did not include the precursors of utilization shown in Figure 5, as they examined a direct link from fit to utilization. This finding is important because it further encourages to focus on fit in this thesis. However, it should be noted that the results from Goodhue and Thompson (1995) do not suggest utilization not having a performance impact, rather they show contrary to prior research on utilization stream that the utilization alone is not an adequate component in explaining performance impacts.

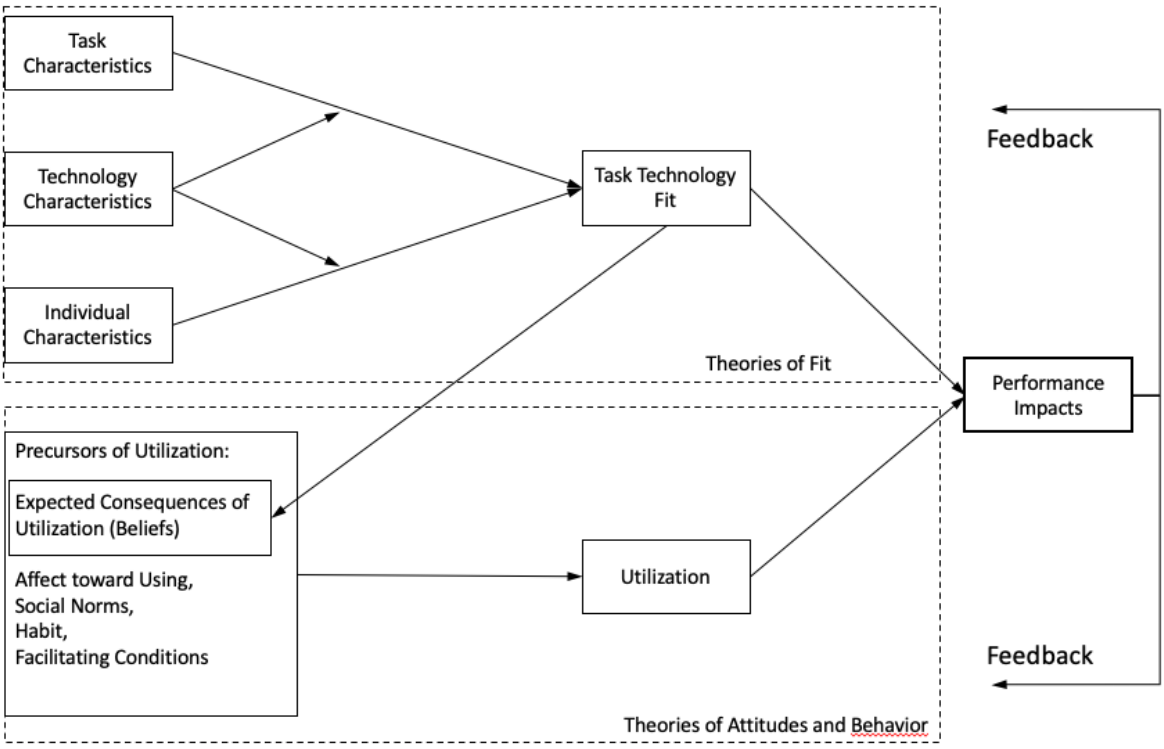

Figure 5. Technology-to-Performance chain

Source: Goodhue and Thompson (1995)

As shown above, the combined TPC by Goodhue and Thompson (1995) includes task, technology, and individual characteristics, and correspondence of these generate the 'fit'. Goodhue and Thompson (1995) describe that task characteristics as elements that affect how the user relies on certain aspects of the information technology and find 'non-routineness' of the task as an example in their research. They leave room for adjusting the granularity of technology characteristics and drop individual characteristics from their reduced model for testing. Goodhue and Thompson (1995) used quality, locatability, authorization, compatibility, ease of use/training, production timeliness, systems reliability, and relationship with users as the factors for explaining TTF. Cane and McCarthy (2009) add that to deepen the understanding behind IS usage and to enhance the measurement of perceived impacts, subsequent literature has extended those variables and provided alternatives for measuring Task-Technology Fit.

Identifying TTF factors is not the only difference in extant literature regarding TTF. Cane and McCarthy (2009) find in their meta-analysis of TTF that along with factors and methodologies, even the definition of the theory itself and its components vary. Zigurs and Buckland (1998, pp. 313) continue on this thought by stating that 'no generally accepted theory of task/technology fit has emerged'. The varying usage of the framework is somewhat evident also in TTF literature in the Telehealth domain. For instance, in their video versus telephone nurse workflow research Cady and Finkelstein (2014) don't explicitly state the TTF components or factors of fit. Despite many similarities with the original TTF model, Serrano and Karahanna (2016) in their TTF-based research on e-consultation use task requirements, technology, and user capabilities (see Figure 6) instead of task, technology, and individual characteristics proposed by Goodhue and Thompson (1995). The interpretation used in this thesis is that these requirements and capabilities are the embodiment of more general characteristics used in Goodhue and Thompson (1995). More on this interpretation will be presented in the following section. Furthermore, as Figure 6 shows, the fit is not a separate component of the TPC chain but in Serrano and Karahanna (2016) the fit is implicit and evaluated by the performance impact.

Next, the thesis will focus on these individual/user and technology characteristics or as referred later as technology *capabilities*, task characteristics or as referred later as task *requirements* and finally on the task performance by discussing their usage in the seminal article by Goodhue and Thompson (1995) and by enriching these elements by introducing

some factors from prior research that are more relevant regarding e-consultation. A more detailed framework used in this thesis will be presented in Section 2.5. This enables the thesis to stay within the TTF framework and to gain more depth at the same time.

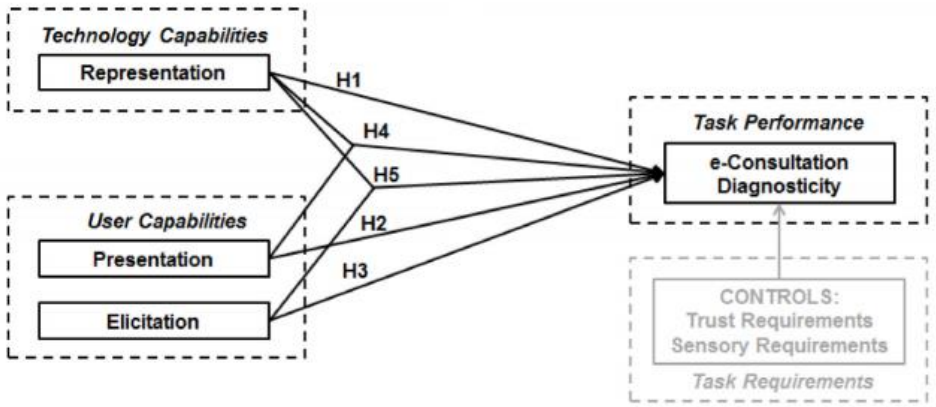

Figure 6. Research model used by Serrano and Karahanna (2016).

2.3.2. Task requirements

TTF defines task characteristics on a rather general level as it describes task characteristics as elements that affect how the user relies on certain aspects of the information technology (Goodhue and Thompson, 1995), and the seminal paper provides *non-routineness* and *interdependence* as examples. The high-level definition is understood as TTF provides a generalizable framework that leaves room for interpretation and modification. Multiple studies follow the task characteristics interpretation by Goodhue and Thompson (1995) and use high-level task characteristics e.g. *access*, *knowledge building,* and *problem-solving* as listed by Cane and McCarthy (2009).

However, TTF literature seems to have a second interpretation regarding the task characteristics, where the focus is not on the nature of the task but rather on the actual requirements of the task. Hence, if the characteristics of the task are interpreted in this way, they reflect the task requirements and provide an answer to the question of *what is required to accomplish the task*. This interpretation seems far less generalizable since it is more related to the specific task that is being examined. Cady and Finkelstein (2014), Serrano and Karahanna (2016), and Mburu and Oboko (2018) along with other papers listed in Cane and McCarthy (2009) seem to follow this interpretation. Hence, a more specific examination regarding e-consultation task requirements is needed. Another reason for using task

requirements instead of characteristics is that these requirements bind TTF and PVT frameworks not only semantically but on their components as well. Indeed Serrano and Karahanna (2016), as shown in Figure 6, form their task requirements akin to PVT: trust (relationship) requirement and sensory requirement. Mburu and Oboko (2018) expand the list and use all requirements from PVT by including also the identification and synchronism requirements. Literature has found support for task characteristics or task requirements impacting significantly to task-technology fit (see e.g. Goodhue and Thompson, 1995; Overby and Konsynski, 2010; Mburu and Oboko, 2018; Wang *et al.*, 2020).

Although the technology capabilities and task requirements may in some cases sound similar, considering the TTF framework it should be remembered that the requirements describe the task needs and finally, the fit describes to which extent the capabilities of the user and the technology meet these needs. Hence, the synchronism requirement originally from PVT and Media Synchronicity that is discussed more thoroughly in Section 2.4, for instance, do approach the same factor but from different perspectives. Next, the technology capabilities in TTF will be discussed.

2.3.3. Technology capabilities

Goodhue and Thompson (1995) state that technology characteristics could be measured along multiple dimensions. In their paper in the empirical part, they examine the particular system used and the department of the user as technology characteristics. They reason such choices with a simplifying assumption stating 'the characteristics of any given system are the same for all who use that system' (Goodhue and Thompson 1995, pp. 222). The vague description of technology characteristics by Goodhue and Thompson (1995) calls for more specific elements to be examined in terms of technology characteristics. TTF research has indeed used multiple dimensions in interpreting the technology characteristics. Some (e.g. Overby and Konsynski, 2010; Serrano and Karahanna, 2016; Mburu and Oboko, 2018) lean on the PVT moderating constructs: representation, reach, and monitoring capability. Wang *et al.* (2020) use technology functionality and design as examples of technology characteristics in healthcare wearable devices acceptance research. Cady and Finkelstein (2014) examine the difference between telephone and video-mediated task performance and although not explicitly stating so, focus to some degree on the representation capabilities. The TTF meta-analysis by Cane and McCarthy (2009) reveals the plethora of examined dimensions regarding task characteristics.

The concept of technology characteristics must be narrowed already in this phase of the thesis to provide the needed depth. Hence, technology capabilities here refer to the relevant technology characteristics that are needed to, at minimum, reach the requirements of the task. From now on, the technology capabilities discussed in this thesis refer to the representation, reach and support for synchronicity capabilities of the technology. The conceptual framework discussed in Section 2.5 includes these capabilities but in this section, the focus is on the previous TTF literature that also uses these capabilities. More specifically representation and reach capabilities are discussed in this section and the support for synchronicity is included in Section 2.4.

Akin to Serrano and Karahanna (2016), representation, already familiar to us from PVT, is examined more thoroughly as an element of technology capability. Supporting results are found in telemedicine research regarding representation and its impacts on diagnosticity and care workflow efficiency. Both Edison *et al.* (2008) and Serrano and Karahanna (2016) in their field study found significant support for representation impacting telemedicine diagnosticity. Cady and Finkelstein (2014) found that when changing from phone to video-mediated conversations nurses were able to use the additional information given by video to diagnose building and making further treatment results so that the efficiency of the workflow was not significantly sacrificed. Despite promising support for representation affecting diagnosticity, Serrano and Karahanna (2016) find conflicting results in their experimental study, as they conclude that in terms of diagnosticity representation matters only when user elicitation or presentation capabilities of clinician and patient are low. Third, changing the level of representation by changing from phone to video-mediated conversation may affect the whole dynamics of the conversation (Cady and Finkelstein, 2014).

The relationship between representation and sensory requirements appears in many forms. As Serrano and Karahanna (2016, pp. 601) suggest 'relevant representation capabilities in this [e-consultation] context are the ability of the technology to transmit (1) the communication cues needed to facilitate effective information sharing and (2) the sensory information needed to perform relevant physical evaluations.' As mentioned above existing literature finds supporting results regarding the telehealth physical evaluations and diagnosticity. Yet, effective and efficient information sharing is highlighted in this chat-mediated e-consultation context where the media richness is lower, and where efficiency is examined. Leaner media, such as email or text-based chat, increase the possibility of

inaccurate communication and spending more time on resolving the miscommunications, which is due to greater difficulty resolving ambiguity and facilitating understanding (Byron, 2008). More on these convergence processes will be discussed in Section 2.4. The propositions of PVT suggesting a positive moderating effect of representation on sensory requirements and fit should not be taken for granted. Results by Overby and Konsynski (2010) show that even though representation had a significant positive impact on the fit, the results did not find significant support for representation capability moderating the sensory requirements positively.

According to Overby's (2008) propositions, representation as a moderating construct is assumed to positively moderate not only sensory requirement but relationship requirement as well regarding process virtualization. Serrano and Karahanna (2016) also acknowledge this as they further disassemble communication cues in information exchange to affect both communication in problem-solving and trust and relationship building. The primary form of communication in chat conversations is even more limited than video or phone conversations and they do not provide auditory or visual information but rely on textual representation, which suggests that the representation capabilities are not inherently very high in chat and may thus hamper the communication in problem-solving and trust and relationship building.

Changes in representation capabilities may have versatile impacts on performing the task. For instance, Cady and Finkelstein (2014) found that nurses were multitasking more when communicating via phone. However, their research showed that changing from phone to video-mediated telehealth conversation with increased visual information had no impact on care coordination workflow efficiency since the information available via visual cues was exploited to support diagnosis and treatment decisions. This finding suggests that the nurses with their actions can compensate the lack of visual information when communicating via phone. This is in line with results from Serrano and Karahanna (2016) where they examine this compensatory interaction between user and technology capabilities. These user capabilities will be touched on in the next section. Moreover, the dynamics of the conversation may change when changing from phone to video-mediated communication. For instance, when a child is a patient to be treated via phone, their parent is the sole communication partner with the nurse, whereas via video the nurse may expand the interactions to include the child (Cady and Finkelstein, 2013, 2014). In addition, the results from Li, Rai and Ganapathy (2020) suggest that diagnostic complexity together with

representation capabilities have a greater impact on patient satisfaction when the diagnostic complexity is high. Hence, in chat where presumably the perceived media richness would be perceived low by the patient, the results from Li, Rai and Ganapathy (2020) would suggest that patient satisfaction would be more sensitive when the diagnostic complexity of the case is high.

Therefore, representation as a technology capability has a diverse role in performing the tasks. Burton-Jones and Grange (2013) dig even deeper to representation as they examine representation theory from effective Information Systems use perspective that reaches beyond the boundaries of virtual processes. Although of great importance in understanding the profound role of representation in IS use, this perspective goes beyond the scope of this thesis.

To gain a more complete set of technology capabilities, reach and support for synchronicity are also examined. Similar to the representation capability, the reach technology capability is derived from PVT moderating constructs (Overby, 2008). Reach capability seems less examined at least in telehealth TTF literature. Moreover, the results in Overby and Konsynski (2010) suggested a positive relationship between reach and fit but found no significant support regarding its explanatory power. As discussed earlier, according to Process Virtualization the reach has a positive moderating impact via relationship requirement and synchronism requirement. However, regarding the e-consultation task, the impact of reach on efficient task performance seems unexplored. It is expected that while the reach enables maximizing the spread of virtual service benefits, it may propose some challenges as well, due to lack of locality for instance. The reasoning behind including the support for synchronicity capability along with a more profound analysis of it is presented in Section 2.4.

2.3.4. User capabilities

Overby and Konsynski (2010) crystallize the role of individual characteristics by reasoning that a combination of task and technology may result in a good fit for one individual but not for another and the individual characteristics are causing this fluctuation in fit. Despite the central role the individual has in TTF, in their TTF seminal paper Goodhue and Thompson (1995) describe individual characteristics by mentioning training, computer experience, and motivation as potential factors impacting technology utilization. Although including individual characteristics as a part of their *Technology-to-Performance Chain* they exclude

these from their reduced model for testing. Serrano and Karahanna (2016) argue that the main emphasis in existing empirical IS research has been on theorizing and examining the relationship of task and technology in determining task performance, which is supported by Cane and McCarthy (2009) TTF meta-analysis. This is somewhat contradictory since the user capabilities are in a key role in separating TTF from other theories (Serrano and Karahanna, 2016). Papers (e.g. Overby and Konsynski, 2010; Serrano and Karahanna, 2016; Mburu and Oboko, 2018) using an integrated model of TTF and PVT face this new dimension as PVT does not provide individual characteristics as a factor. Moreover, the studies including also the user characteristics have lacked depth in this regard by focusing on either technology-neutral and task-neutral individual differences or technology-specific user characteristics (Serrano and Karahanna, 2016). Research has used e.g. computer literacy, computer self-efficacy, and prior experience as individual characteristics (Cane and McCarthy, 2009). The missing part in the extant literature, according to Serrano and Karahanna (2016, pp. 598), is the task-specific user capabilities that they describe as 'individual abilities that pertain to the focal task(s) that the user aims to accomplish when using an IS, and these abilities can exist and be developed independently of IS use'. Regarding the focal task of composing an email, they use writing skills as an example of task-specific user capabilities. Regarding e-consultations Serrano and Karahanna (2016) find presentation from the patient side and elicitation from the clinician side as relevant task-specific capabilities. User capabilities understood in this manner, undoubtedly provide more depth to understanding the role of the individual and the dimensions that may affect the task performance regarding the capabilities and characteristics of an individual. Conversely, when emphasizing the task-specific user capabilities, however, the focus is shifted away from the co-existence of task, individual, and technology.

While task-specific user capabilities focus on the focal task, the compensatory user capabilities examined by Serrano and Karahanna (2016) bring the task, the technology, and the individual back together. The compensatory user capabilities are adaptive capabilities of the individual which they may cope with when facing some shortages of the used technology. The results from Serrano and Karahanna (2016) find that with the help of compensatory user capabilities the users can reach e-consultation diagnosticity even when the representation capabilities of the technology are low.

2.3.5. Efficiency and performance

At the core of TTF are the performance impacts that relate to individual accomplishing the portfolio of tasks and higher performance meaning improvements in efficiency, effectiveness, higher quality, or a mix of these (Goodhue and Thompson, 1995). Regarding TTF, there is no standard for defining the measurement of performance. Cane and McCarthy (2009) showcase this plethora of definitions and measurements regarding TTF performance. The research setting affects the definition of performance or the impact of TTF overall. As Overby and Konsynski (2010) and Mburu and Oboko (2018) showcase, in some context it is not even reasonable to include task performance as a dependent variable since the definition of 'good' or 'bad' performance is not attainable, hence utilization may provide a better foundation for measuring task technology impacts in these settings. While proposing a general framework Goodhue and Thompson (1995) use changes in perceived effectiveness as a measure for performance impacts, while Serrano and Karahanna (2016) and Cady and Finkelstein (2014) use more task-specific performance indicators: diagnosticity and time used for the task, respectively. More specifically Serrano and Karahanna (2016, pp. 599) describe that in e-consultation telehealth context 'task performance reflects the extent to which system use enables the expert to effectively diagnose client's problem.' However, the linkage between perceived performance as used in Goodhue and Thompson (1995), or other User Evaluations of performance, to objective performance measures is not unproblematic. Goodhue, Klein and March (2000) find that while User Evaluations can correctly reflect task-technology fit, and task-technology fit can predict performance, the relationship between User Evaluations and objective performance is not strongly supported. Their results suggest that the lack of support between User Evaluations and objective performance is prevalent when the users have inadequate information on the impacts of changed TTF conditions on task performance. In their research, the User Evaluations reflected performance better when the performance was measured with time used for the task and weaker when the task performance was measured by accuracy since accuracy outcomes were not as easily available for the users. Based on such results, Goodhue, Klein and March (2000) propose that the linkage between User Evaluation and actual performance is stronger when the users receive feedback on their performance. How these findings affect this thesis will be discussed alongside the conceptual framework in Section 2.5.

Performance indicators and definitions are many in IS research. Naik and Kim (2010), although using Extended Adaptive Structuration Theory instead of TTF, use two variables that define the effectiveness of virtual teams: performance and satisfaction. They use solution time and solution quality as elements of performance while they define satisfaction by two dependent subjective variables that are solution satisfaction and satisfaction with the experience of working in a virtual team (Naik and Kim, 2010). These dimensions of outcome gather the relevant information also regarding this thesis even if the context, theoretical framework, and task are different. Using these elements, it is clear that Serrano and Karahanna (2016), with their diagnosticity measures, measure solution quality while Cady and Finkelstein (2014) rely on the solution time aspect.

As the task in this context is heavily dependent on Information Systems use, the concept of effective and efficient IS usage becomes also important. However, Burton-Jones and Grange (2013, pp. 654) argue that effective IS use is a complex concept and extremely understudied. They summarize efficiency as 'a dimension of performance referring to the extent of goal attainment for a given level of input (such as effort or time)'. While Serrano and Karahanna (2016) acknowledge and approve the conceptualization of effective system use by Burton-Jones and Grange (2013) where user, technology, and task form the three fundamental elements that define the essence of system use, they call for an expanded viewpoint where also the importance of user's interactions with each other is highlighted. Naturally, this viewpoint stems from the context where communication between users is required.

2.4. Media Synchronicity Theory

Chat differs from face-to-face, video, and phone-mediated conversations, and in this section, the focus is on how and why it differs in terms of media synchronicity.

Media synchronicity theory (MST) by Dennis, Fuller and Valacich (2008) examines to which extent the ability of the media supports synchronicity. They define synchronicity as 'a shared pattern of coordinated behavior among individuals as they work together' (Dennis, Fuller and Valacich 2008, pp. 575). MST was developed since the widely used Media Richness Theory by Daft and Lengel (1986) lacked convincing results in empirical tests with 'new media' (Dennis, Fuller and Valacich, 2008). It is important to understand the difference between synchronous communication and synchronicity. Especially with media low in social presence even the synchronous communication does not imply information

synchronicity (Miranda and Saunders, 2003). Thus, to reach synchronicity, synchronous communication in MST is seen as a necessity but on its own, it is not enough since individuals who are working synchronously do not necessarily reach synchronicity (Dennis, Fuller and Valacich, 2008). In other words, the frequency of messages sent and received does matter, but the actual information of the message to be shared from the sender to the receiver determines whether synchronicity is achieved. The media synchronicity describes how the medium supports this synchronicity and more specifically to which extent 'the capabilities of a communication medium enable individuals to achieve synchronicity' (Dennis, Fuller and Valacich 2008, pp. 581).

Sharing and understanding of this information via communication require two primary processes: conveyance and convergence, where conveyance processes to put simply, mean the transmission of new information, and convergence processes mean the sense-making and discussions about individual's interpretations of the situation that is based on the already transmitted and thus preprocessed information (Dennis, Fuller and Valacich, 2008). Although MST suggests that these two are co-existing in communication processes, understanding the differences between these two are important because they have different needs in terms of reaching good communication performance. MST proposes that since convergence processes usually need rapid back-and-forth messaging, to achieve better communication performance, media that supports higher synchronicity should be used for convergence processes, and media supporting lower synchronicity should be used with conveyance processes (Dennis, Fuller and Valacich, 2008). The results from Randall (2011) in a virtual team setting support these proposals.

What are then the media capabilities that support the development of synchronicity hence ultimately impacting the communication performance? Dennis, Fuller and Valacich (2008) find five media capabilities: symbol sets, parallelism, transmission velocity, rehearsability, and reprocessability. These are illustrated in Figure 7.

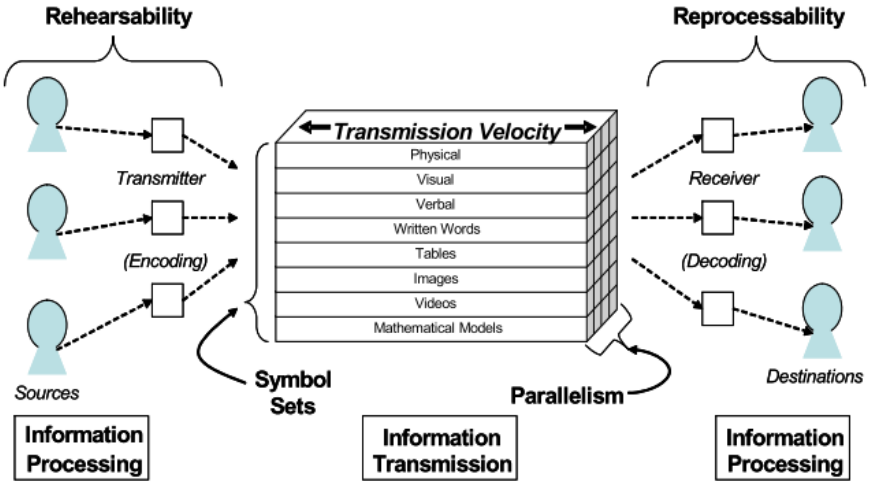

Figure 7. Communication System and Media Capabilities
Source: Dennis, Fuller and Valacich (2008)

Symbol sets define how versatilely a medium allows information encoding for communication and includes the Media Richness Theory dimensions from Daft and Lengel (1986) regarding *multiplicity of cues* and *language variety*. Parallelism describes the possibility of having multiple simultaneous transmissions effectively and transmission velocity is the message delivery speed of the medium. Rehearsability expresses how the media supports editing or 'fine-tuning' the message before sending, whereas reprocessability enables accessing and re-examining the message after sending or receiving it. (Dennis, Fuller and Valacich, 2008)

As Figure 8 by Dennis, Fuller and Valacich (2008) illustrates, the MST proposes that out of these five media capabilities increased ability to support wide symbol sets and high transmission velocity are the only ones that positively affect media synchronicity, therefore parallelism, rehearsability, and reprocessability decreasing media synchronicity. Randall (2011) finds support for only some of these proposals in the virtual team setting. He finds support for wide symbol sets increasing media synchronicity but makes conflicting observations on the impacts of parallelism, rehearsability, and reprocessability on communication efficiency. Results from Randall (2011) suggest that the positive effects that parallelism, rehearsability, and reprocessability have can top the negative ones on synchronicity thus enabling better communication efficiency amongst virtual teams. E.g., despite rehearsing or reprocessing the messages decrease the message transmission rate, they

enable greater communication accuracy by decreasing the risk for miscommunication (Randall, 2011).

Figure 8 also encapsulates the essence of MST framework with its multifaceted dynamics brought by media synchronicity, conveyance and convergence communication processes, appropriation factors, and the fit that they collectively impact, therefore determining the communication and task performance. In addition to media capability related proposals, MST suggests that accumulated experience and established social norms between the individuals participating in the communication, the context and the task affect the need for media synchronicity so that increase in experience and existence of established social norms enables lower need for the synchronicity of the media (Dennis, Fuller and Valacich, 2008). Moreover, as both conveyance and convergence processes are needed the MST suggests using a mix of mediums to achieve better communication performance (Dennis, Fuller and Valacich, 2008).

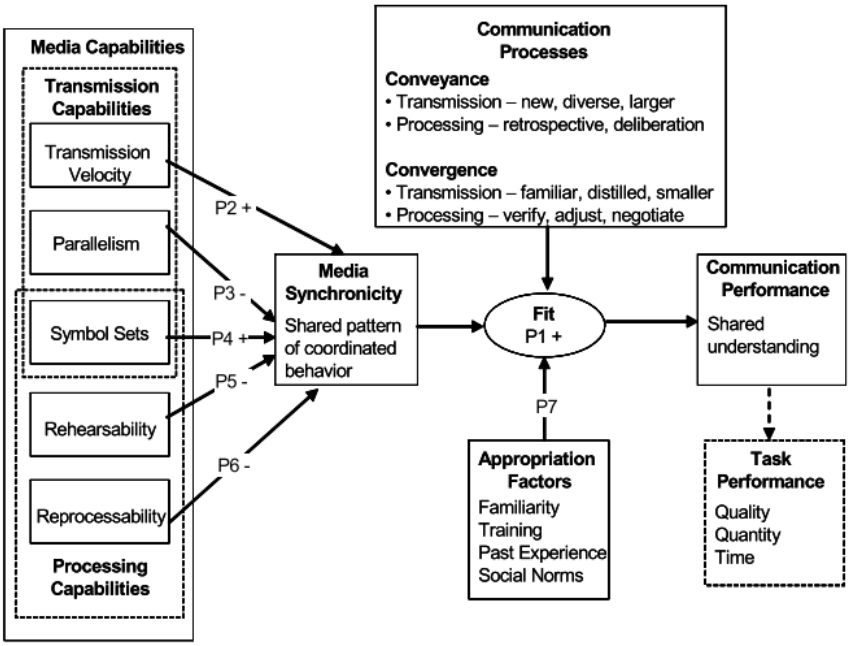

Figure 8. Media Synchronicity Theory
Source: Dennis, Fuller and Valacich (2008)

MST has been used in various research settings. These include papers examining team communication (Randall, 2011; Lam, 2016), choosing the right communication tools in global software development (Niinimäki *et al.*, 2012) or overall in distance communication (Skopp *et al.*, 2015), and on analyzing Twitter symbol set width and usage (Son *et al.*, 2019). Previous research has found MST useful due to its capability to aid in selecting the right media for the communication task (Randall, 2011; Niinimäki *et al.*, 2012; Skopp *et al.*, 2015)

or due to its useful components that help in understanding and identifying factors that contribute to communication process efficiency (Lam, 2016; Son *et al.*, 2019).

MST touches on multiple other theories and their dimensions. Although approaching the task performance from a different perspective, and according to Serrano and Karahanna (2016) lacking the user ability perspective, the MST has multiple similarities to Task-Technology-Fit theory that was discussed in Section 2.3. The symbol sets is seemingly a similar dimension to Media Richness Theory dimensions where Daft and Lengel (1986) used *multiplicity of cues* and *language variety.* Dennis, Fuller and Valacich (2008) want to make a distinction between media capabilities and appropriation factors by arguing that prior media theories have interpreted socially derived characteristics, for instance, those based on experience, as media characteristics, therefore, linking a portion of appropriation factors too closely to the essence of the media. For instance, the social norms and experience of using video-mediated communication may drastically differ from the ones regarding chat communication and thus one may link these appropriation factors too closely to the nature of the media itself. Dennis, Fuller and Valacich (2008) differentiate MST from the other media theories by arguing that MST acknowledges the rapid growth rate of new capabilities the media tools acquire, and thus specific digital mediums should no longer be referred to but the set of features that they offer instead. Table 2 presents examples of mediums and a comparison of their capabilities.

	Transmission Velocity	Parallelism	Symbol Sets	Rehearsability	Reprocessability	Information Transmission	Information Processing	Synchronicity
Face-to-face	High	Medium	Few-Many	Low	Low	Fast	Low	High
Video Conference	High	Medium	Few-Medium	Low	Low	Fast	Low	High
Telephone Conference	High	Low	Few	Low	Low	Fast	Low	Medium
Synchronous Instant Messaging	Medium-High	Low-Medium	Few-Medium	Medium	Medium-High	Medium	Low-Medium	Medium
Synchronous Electronic Conferencing	Medium-High	High	Few-Medium	Medium	High	Medium	Medium	Low-Medium
Asynchronous Electronic Conferencing	Low-Medium	High	Few-Medium	High	High	Slow	High	Low
Asynchronous Electronic Mail	Low-Medium	High	Few-Medium	High	High	Slow	High	Low
Voice Mail	Low-Medium	Low	Few	Low-Medium	High	Slow	Medium	Low
Fax	Low-Medium	Low	Few-Medium	High	High	Slow	High	Low
Documents	Low	High	Few-Medium	High	High	Slow	High	Low

Table 2. Comparison of Selected Media and Their Capabilities

Source: Dennis, Fuller and Valacich (2008)

2.5. Conceptual framework

The conceptual framework of this research is presented in Figure 9 and is heavily based on the one presented by Goodhue and Thompson (1995). The conceptual framework used in this thesis fulfills the TTF framework by Goodhue and Thompson (1995) by adding task elements from Process Virtualization Theory and Media Synchronicity Theory, therefore, contributing to IS research.

Process Virtualization Theory, with its main constructs, enables to focus on the task requirements regarding the change from traditional to virtual processes or between two differently virtualized processes. Even if this domain-independent framework of PVT may lose some domain-specific characteristics, it provides a useful lens that gathers the key elements affecting the move from traditional to virtual processes. Within this thesis, virtuality is an inseparable characteristic that affects fundamentally the nature of the process and thus it cannot be siloed and discussed as one of the factors. The key process of consulting the clinician has already been virtualized, thus the role of PVT in this thesis is not to evaluate how the process should be or should have been virtualized. Rather, and in terms of the research question, PVT helps to examine the very nature of the e-consultation process as well as to understand what kind of advantages and disadvantages IT-enabled process virtualization brings.

Task-technology fit fulfills the moderating constructs perspective from the PVT framework by providing a close-up to the interplay of technology, task requirements, and individual capabilities. It also raises the important question of how to define better performance. TTF is used as a theoretical framework in this thesis since it weaves together task requirements, technology, and user capabilities. The Task-Technology fit and Process Virtualization frameworks have been integrated into the same model successfully in prior research (e.g. Overby and Konsynski, 2010; Serrano and Karahanna, 2016; Mburu and Oboko, 2018). Even if the focus of Serrano and Karahanna (2016) is on the perceived diagnosticity and the focus of this thesis is on the perceived efficiency of the process, the core process of e-consultation is the same. Therefore, the task requirements included in the conceptual framework of this thesis closely follow the ones used by Serrano and Karahanna (2016).

Trust and relationship requirement usage in this thesis provides an example. As the need for interacting with one another is crucial and built-in in this dyadic e-consultation process the focus regarding this requirement is on trust and rapport building.

In this thesis, the synchronism requirement is included as one of the task requirements. The reason for this addition when compared to Serrano and Karahanna (2016) originates from the nature of chat conversations where the synchronicity differs from phone and video-mediated conversations. As chat-mediated telehealth literature is scarce and both video and phone mediated consultations do not significantly differ from physical expert consultation in terms of their synchronicity, this synchronism requirement has not been widely studied. Using synchronism requirement as a task requirement is also motivated by Process Virtualization Theory (Overby, 2008) in this virtual e-consultation. Despite great importance in the general framework of PVT and the major impact that strong identification has on the e-consultation process and its efficiency, identification and control requirements won't be discussed in great detail in this thesis.

To provide more depth to the technologic capabilities Media Synchronicity Theory is added to the mix. MST sheds light on the technology capabilities by offering dimensions that are highly relevant in this chat e-consultation focused research question. More specifically the conceptual framework includes five media capabilities from MST: symbol sets, parallelism, transmission velocity, rehearsability, and reprocessability. The fundamental question in TTF is, does this fit and the utilization of the technology lead to better individual performance. In this thesis, however, the approach is somewhat reversed. Enhanced individual performance is not assumed, rather, the thesis tries to first understand if the individuals perceive the impact of the usage of the technology on their task performance as better or worse than in other consultation forms, and based on the result, underlying factors are segregated. The conceptual framework and its granularity is a result of balancing between staying within the scope of the thesis but at the same time not narrowing down the potential factors contributing to the perceived efficiency.

The arrows from Technology in Figure 9 represent the moderating effects that the technology has on the task requirements and the user. The first arrow conceptualizes how the technology capabilities fulfill the task requirements. The second arrow encapsulates the joint impact of user compensatory capabilities and technology capabilities. These compensatory capabilities between technology and user might be either technology-driven

or user-driven. Hence, the interpretation is that the technology may compensate some lacking user capabilities and vice versa. Serrano and Karahanna (2016) provide examples of this compensatory interaction between user and technology and given the limited representation capabilities of the technology, they focus on the user compensatory capabilities balancing this limitation.

Regarding the performance measures, in this thesis, the focus is on the perceived performance impacts given by the clinicians themselves, hence in line with Goodhue and Thompson (1995). Instead of focusing on the solution quality as in Serrano and Karahanna (2016), this thesis leans more on the solution time as in Cady and Finkelstein (2014) and its efficiency barriers. Three main reasons affected this performance definition. First, the initial and preliminary research question rose from the identified efficiency differences between chat user groups, and this efficiency was defined more heavily on time perspective rather than quality perspective. Second, it is assumed here that regardless of the consultation form (physical, video, telephone, or chat), the clinician should not accept significantly decreased diagnostic confidence that is caused by lack of representation capabilities of the medium for instance. In such cases where the diagnostic confidence is sacrificed the clinician is expected to guide the patient to further examination. Thus, the diagnostic confidence caused by the change in consultation form should, ideally, reflect the need for further treatment and not the outcome of the treatment. This assumption is extremely strong, lacks scientific proof, and is done only to avoid the constant balancing between solution time and quality. Third, Goodhue, Klein and March (2000) propose that the User Evaluation, such as perceived efficiency, reflects objective performance measures better when the feedback of the performance is available to the users. Since the users can access their task performance when it is measured as time used for the task, the perceived efficiency should to some extent reflect the actual performance. More specifically, when the users compare different consultation forms in terms of time used for the task, the differences between different Task-Technology Fit conditions should be reflected by perceived efficiency to some extent because the users can estimate which kind of impacts changed TTF conditions have on task performance. To conclude, the emerging perceived efficiency conceptualizations will not be neglected but the main focus will be on the time aspect of the e-consultation efficiency regarding especially the medical staff perspective. Hence, this measure in a quantitative research would be reflected by the *chat e-consultation*s *per hour* indicator and this indicator reflected the interview question setting.

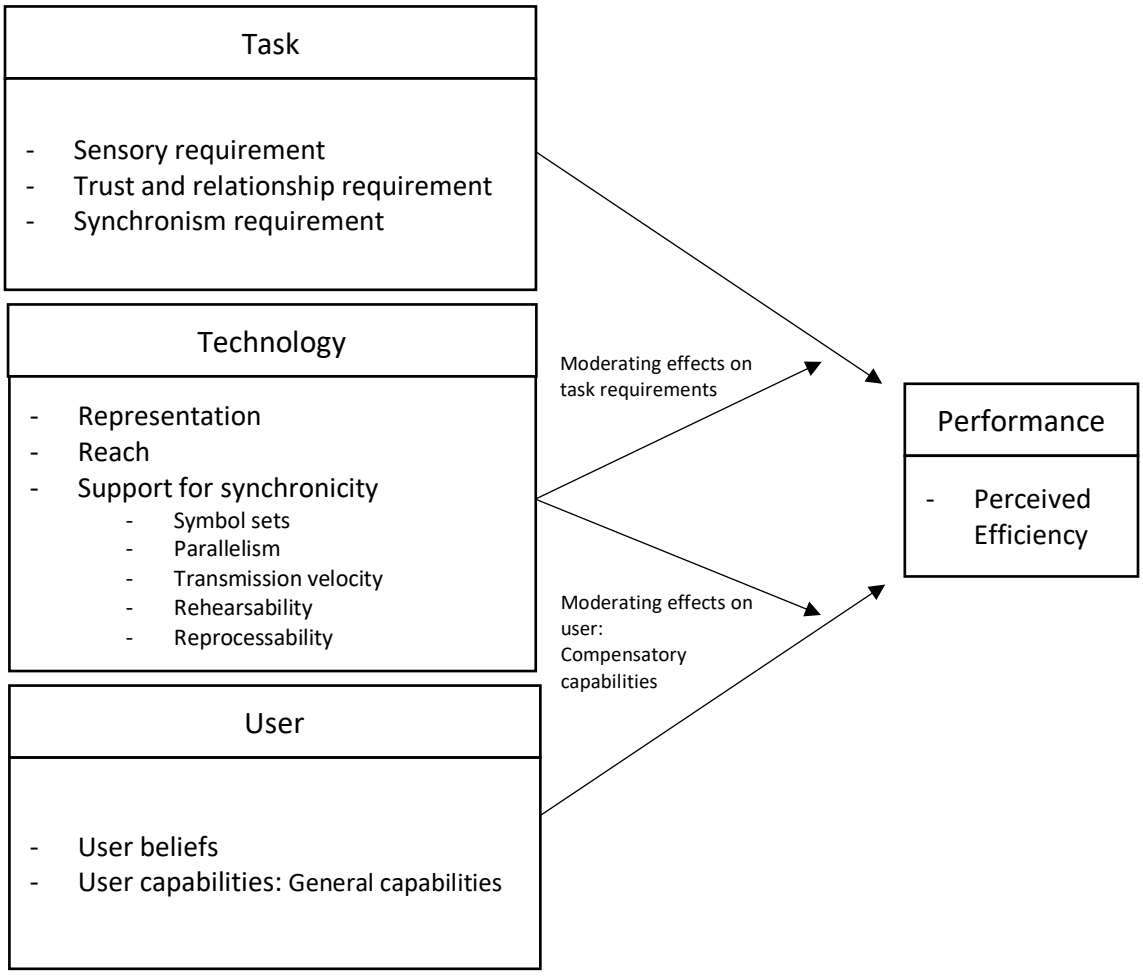

Figure 9. Conceptual framework

3. Methodology

In this chapter, the research methodology will be discussed. The first section focuses on the methodological approach, the second reveals the methods used for data collection and the third section discusses the analysis methods. This chapter also presents the case setting.

3.1. Research method

This research was conducted as a qualitative case study research with one company and two user groups. The case was identified by the case company since the two user groups, physicians and nurses, were performing differently in chat e-consultations according to the available quantitative data. After an initial literature review, the managers were interviewed to get an in-depth understanding regarding chat service production and management,

differences between these two user groups, and differences in their focal tasks regarding the chat e-consultation. During these interviews, it became clear that due to the fundamental differences between these groups and their e-consultation tasks, the comparative perspective was abandoned, and the focus shifted towards explaining and finding factors that contribute to the efficiency of the chat consultation. Since the two different user groups had different backgrounds in their experiences regarding the consultation forms, this offered a fruitful opportunity to examine consultation form differences between mainly chat, in-person, and phone consultations. The research problem yielded the research question of *how does perceived efficiency of chat e-consultations differ from other consultations forms and why*.

Since the case study approach suits especially well to *how* and *why* research questions (Yin, 2018) and to research problems in which comparing, in-depth understanding, and evaluating are needed, the case study approach was selected. The primary data collection from semi-structured interviews and secondary data collection from existing documents were used and will be discussed more thoroughly in the next section. The thematic analysis approach used in this thesis and the philosophical position will be discussed later in this chapter.

3.2. Empirical data collection

This section describes how the empirical data was collected. First, the focus is on the primary data collection from interviews, and second, on the secondary data collection from existing documentation in the case company.

3.2.1. Interviews

The suitable interviewee candidates were found with the help of the managers and supervisors who listed multiple candidates with varying backgrounds. The pools of candidates were formed separately regarding the nurses and the physicians and to ensure the anonymity of the interviewees, the managers and supervisors listed more candidates than what would be interviewed and thus only the researcher knew who would be chosen for the interviews. To ensure confidentiality and thus get the full spectrum of potential factors contributing to perceived chat e-consultation efficiency, and to protect the case company anonymity, the interviewees were decided to be kept anonymous. In total, three managers, one physician customership responsible (PCR), three public health nurses, and three physicians were interviewed. Since the titles of the interviewees vary a little and their

anonymity must not be sacrificed, for the sake of simplicity the public health nurses, Digi nurses and occupational health nurses will be all called collectively *nurses* and general practitioners, occupational health physicians, and specialist doctors will be all called collectively *physicians*. The same convention applies to the managers also. Table 3 collects the abbreviations used in Chapter 4 and the numbering is based on the order of the interviews.

Interviewee	Abbreviation used
Manager #1	M1
Manager #2	M2
Manager #3	M3
Physician Customership Responsible	PCR4
Physician #1	P5
Physician #2	P6
Physician #3	P7
Nurse #1	N8
Nurse #2	N9
Nurse #3	N10

Table 3. Abbreviations used in interview result analysis

The manager interviews provided important in-depth information about the production and management of case company chat services, differences among the respondent groups, and their consultation task descriptions. PCR interview provided some information on physician orientation as well as knowledge on collective feedback received from the physicians regarding chat services. After the manager and PCR interviews, the initial guiding interview questions were revisited and edited to suit the more specific and hands-on experience-based knowledge of physicians and nurses.

Semi-structured interviews were chosen as the interview form in this thesis. Semi-structured interviews - the interview form most frequently used in healthcare (Gill *et al.*, 2008) - offer flexibility as they are less formal than structured interviews yet they provide constancy by asking the same, or close to the same questions from each interviewee (Saaranen-Kauppinen and Puusniekka, 2006). The flexibility of semi-structured interviews allows the researcher

to discover such important information from the interviewee that was not thought pertinent before the interview (Gill *et al.*, 2008). The semi-structured interviews in this thesis were roughly one hour long each. Semi-structured interviews (see Appendix for interview questions for the physicians and nurses) were selected as the interview method since the conceptual framework that had a close link to theoretical components provided structure for the interviews, yet not all interviews were held strictly according to the guiding interview questions but were flexible instead. The interviews were held via Microsoft Teams calls and recorded with the help of Microsoft Teams and stored with Microsoft Stream. During the interviews generally, no video feed was used and thus the interviews focused on the audio data only.

3.2.2. Documentation

Existing documentation from the case company's internal integrated management system and video database (Microsoft Stream) was also collected. These secondary data sources included concrete instructions, general orientation material, and handbooks that are used during the orientation period of the physicians and the nurses as well as a database to search current instructions. Such handbooks provided general guidelines such as which ailments can be treated on chat, instructions for the usage of the chat platform, The role of this data source was to shed light on the guidance, and tips that the medical staff receives before they start providing chat e-consultations. The documentation as a data source was examined also since it was assumed that such instructions would include information that is seen valuable to share collectively amongst the medical staff and thus even highlight some differences between providing in-person and virtual consultations.

The data gathered from the integrated management system represented the current (collected in 1/2021 - 5/2021) handbooks and guidelines. The data collected was limited to those handbooks and instructions that discussed only the chat services that were within the scope of the research. Hence, no data was gathered regarding the internal nurse-to-physician consultation chats for instance.

3.3. Analysis of empirical data

After generating the transcriptions, and familiarizing with the data, the interview results were analyzed with thematic analysis. Thematic analysis is a widely used method in qualitative data analysis that strives for identifying, understanding, and highlighting the key themes from the qualitative data (King and Brooks, 2018). Thematic analysis with its many forms offers a versatile method that has broad applications in research with varying topics, interests, and qualitative data set sizes and kinds (King and Brooks, 2018).

The data analysis included organizing data from the interviews and the documentation roughly across two dimensions: first by their factor according to the conceptual framework and second by the prevalence of the finding among the data. Organizing the data by the factors in the conceptual framework was done initially only loosely so that the emerging themes and findings were not abandoned. This enabled to segregate the most impactful factors affecting the perceived efficiency of e-consultations and simultaneously to stay within the scope of the research.

The research strongly leaned on the theory-linked a priori themes and drawing on the ontological and epistemological categorization by King and Brooks (2018) it had a realist and realist to constructivist positions regarding its ontology and epistemology respectively. Since the Task-Technology fit theory heavily guided the conceptual framework the body of the guiding interview questions and thematic analysis had clear links to TTF components. Goodhue and Thompson (1995) suggest that TTF with its components could be the basis for a diagnostic tool to analyze whether the user needs are met with the current information systems used in the organization, which supported the approach for the thematic analysis with theory-linked a priori themes in this research.

3.4. Case setting and task description

The case focuses on nurses and physicians that provide chat e-consultations. The case company offers different chat consultations that are not restricted to the ones presented in this thesis, but the specific nurse and the physician chats were elected to limit the scope of this research. Within the scope of this thesis, the nurses and the physicians meet patients via different chat services where the customers may be either private customers or occupational

healthcare customers. While the chat platform, the tools used and the task of *treating the patient or guiding the patient for future treatment* are the same between these nurse and physician chats, there are major differences between the groups.

Nurses interviewed in this thesis come from various backgrounds and some having also recent experience on in-person consultations. Currently the interviewed nurses, however, do not offer in-person consultations and thus in addition to chat consultations mostly offer phone consultations. Due to this consultation service spectrum, the nurse interviews focused on finding chat e-consultation differences to phone e-consultations. One of the chats offered by the nurses is the Digi nurse chat where the focal task differs from other tasks. In Digi chat, the nurses assess the treatment need for the patient ailment and thus act as gatekeepers for some of the occupational health care customers before they can access physician chat services for instance. This assessment of treatment need affects the dynamic of the chat conversation and thus this nurse chat is not entirely comparable to other nurse chats or physician chats. The nurses have different options for the patient's further guidance if the chat e-consultation is not seen as adequate for treating the patient and these options include guiding the patient to physician chat.

The physicians interviewed in this thesis come from various backgrounds as well. Overall, the physicians interviewed are more experienced in offering in-person appointments in addition to video, phone, and chat e-consultations. Thus, the physician interviews focused on the differences between in-person consultations and chat e-consultations with some specifying questions to examine possible differences also between video and chat e-consultations.

4. Results

In this chapter, the empirical results will be revealed. The results are discussed according to the conceptual framework presented in Section 2.5. The chapter consists of four main sections. The first visits the conceptualization of efficient performance by the interviewees. The second section examines the results from the task requirement perspective and the third section focuses on user beliefs and user capabilities. The fourth section discusses the technology with its moderating effects on first, the task requirements, and second regarding the compensatory interaction between the technology and the user. Hence, the order in this

chapter is different than in the conceptual framework as the performance will be discussed first and the technology with its mediating role will be discussed last.

4.1. Defining efficient performance

The manager interviews revealed that currently, the case company measures chat efficiency with multiple measurements. The most widely used efficiency measurement seemed to be the number of treated patients via chat per hour per medical staff member. This measurement was also used in creating target levels and thus communicated to medical staff. However, due to the differences in service production between nurses and physicians, this measurement was more present in measuring nurse chat efficiency. Other measurements including chat duration measurements are also used by the company, but due to the possibility of having multiple parallel chats, the interview questions were built upon the measurement of the number of treated patients via chat per hour per medical staff member.

The respondents were given the possibility to define 'efficient e-consultation' themselves. This interview question enabled examining how the respondents interpret the efficiency and thus how their responses reflect their judgement on perceived efficiency.

The responses suggested that the traditional efficiency measurements are important, but not enough on their own.

The quality measures were often attached to the efficiency measurement responses since it seems that the medical staff is not willing to sacrifice e-consultation quality in the name of shortsighted efficiency. Understandably the physicians and the nurses concentrated in their answers on maximizing the efficiency of their work within the chat capabilities and thus some of the responses were more qualitative.

> P7: "The e-consultation is efficient when the patient's case progresses, and the patient feels like he/she is being listened and understood…and [when] I have done everything possible that I could do in e-consultation to advance his / her case."

Although this is difficult to quantify, the same concerns are present in the managers' answers. These answers called for measures that would better encapsulate the comprehensive impact of the e-consultation treatment because the traditional measures regarding efficiency and quality are not enough on their own.

M1: “Instead of looking at some individual chat conversations, we should start to follow on whether or not the patient’s cases can be treated with chat…Current measures are definitely something we should keep using, but those need to be expanded to the whole [care] path.”

To conclude, the current measures of efficient e-consultations such as the number of treated patients via chat per hour per medical staff member are seen as important but more comprehensive measurements are needed in the future. To stay within the scope of this thesis the interviewer guided the interviews to focus more on the currently used efficiency measure even though the alternative definitions and responses were not excluded.

4.2. Task

In this section, the results regarding task requirements will be discussed.

4.2.1. Sensory requirement

Both physician and nurse consultations require sensory information for successful and efficient task accomplishment regarding many symptoms. However, the need for auditorial and visual cues – the only two forms of sensory information that can be transmitted with today’s electronic communication technology (Overby, 2008) - varies between different ailments, and thus in some cases, the sensory requirement in task performance is highlighted while in other cases it does not play a pivotal role.

P5: “Let’s say for instance an acute injury, sprained ankle. There is virtually nothing you can say about that [in chat], you really need to examine it. …Whereas when somebody comes [to chat] due to hay fever, then we can have the whole conversation with great quality just as well as in in-person appointments, and then the result is great. Then the lack of sensory dependent observations and physical examinations results are not present.”

N8: “[via phone consultation]… in upper respiratory track symptoms, by hearing the customer’s voice it is easier to deduce in which stage the disease is. For instance, respiratory rate… if the customer gets out of breath during the call, it may tell a lot. In chat the customer cannot express anything else than [with text that] there is breath shortness. If the customer calls and even after the first sentence huffs, it is much easier to assess the situation and how acute it is”

The interview results overall suggest that sensory requirement is evident in physician and nurse e-consultations, but the ailment heavily guides to which degree. When the ailment is suitable for chat e-consultations the chat is indeed seen very efficient as a channel.

> P5: "It is superior, some cases fit very well to chat and actually in those cases there is no sense to treat it elsewhere. Some cases are best suitable for video and in some cases you have to visit a brick-and-mortar unit. The share between these is already settling and during this decade it will find a homeostasis"

4.2.2. Trust and relationship requirement

The interview results suggest that trust is a requirement in the e-consultation task, but with the current realization of the e-consultation it does not seem to affect the task efficiency significantly. When asked whether the strong identification of the patients has any impact on trust-building, the majority of the respondents agreed that the identification adds some inherited trust, but that they had not actively thought about its impacts on the task. Furthermore, the results suggest that chat encourages to go straight to the point and thus somewhat discount the relationship-building activities, which again suggests lowered relationship requirement. This relates also to user beliefs towards the chat and thus it will be discussed more thoroughly in Section 4.3.1.

The initial relationship requirement, at least in terms of long-lasting relationships is not high in this primary care setting, since the physicians and the nurses seem to cope well even if the patients are not known in advance. This low relationship requirement increases the efficiency of the chat e-consultation due to the conversation fast-forwarding or skipping the parts that are related to building or maintaining the relationship. Hence, low relationship requirement increases the importance of the chat as a treatment channel since it enables reaping the benefits from the *reach* capabilities of the technology that will be discussed later in Section 4.4. The results suggest that representation capabilities impact meeting this, lowered although still existing trust and relationship requirement and this moderating effect will be discussed in Section 4.4.1.

4.2.3. Synchronism requirement

Changes in synchronism requirements make chat a truly unique communication medium regarding telehealth e-consultations. All e-consultations whether it is video, phone, or chat mediated suffer, although to a different extent, from lowered sensory information when

compared to an in-person appointment. In this respect, all virtual channels are closer to each other. However, in-person, video and phone mediated consultations all require both participants to be actively present, and thus their synchronism requirement differs from the chat synchronism.

> P5: "I don't do many video e-consultations. You can chatter for ages with the patient in video e-consultations. … when you have these individual [unfamiliar] patients, then I think chat is a more efficient channel. In chat, the patient summarizes their concerns better. Via video, you have to be constantly present which brings the problems familiar from in-person consultations. You don't have those [problems] in chat"

The synchronism in the chat is lower but the results suggest that the e-consultation, the task, requires the synchronic information exchange still to a certain degree. If this lowered but still existing requirement is sacrificed, it affects trust-building, a necessity for the task performance, and thus task performance is shriveled.

> P5: "If the patient is very slow then the trust-building will fail… I don't have any trust towards the patient if he/she answers with few words, with very stiff and slow sentences. It makes you feel that you don't have a connection to him/her. You must have a certain frequency with the patient… and the trust will be created automatically."

Results suggest that the synchronism requirement is not constant throughout the e-consultation. In other words, some phases of the e-consultation settle for asynchronous conversation better whereas some require rapid information exchange. This is especially evident in nurse e-consultations where the nurses reserve appointments for the patients for their oncoming treatment. This phase requires rapid information exchange since the appointment slots suggested by the nurses to the patients are not preliminarily locked in the EHR and the slots may be reserved by someone else even before the patient responds. In later sections, the impacts that this changed synchronism requirement has on efficiency will be discussed from the technology capability and user belief perspectives.

To conclude, the interview results suggest that the synchronism requirement in chat e-consultations is lower when compared to in-person, video, or phone consultations. However, the requirement still exists and may even fluctuate between different e-consultation phases. Moreover, even if the task could be technically performed with low levels of synchronism, the interviewees felt that the task efficiency would be harmed. Thus, when striving for efficient task performance, the synchronism requirement increases.

4.3. User

In this section, user beliefs and user capabilities are discussed. First, the focus is on the beliefs and presumptions that the user and especially the patient side has towards chat conversations. These user beliefs are closely related to the appropriation factors presented in Media Synchronicity theory in Section 2.4. These presumptions could also be interpreted as user-determined task requirements but since the results suggest more technology than task-related assumptions, these user beliefs are discussed in this section. Second, the general user capabilities are examined. These shed light on the highlighted skillsets required from the user. The compensatory capabilities between user and technology will be discussed later in Section 4.4.2.

4.3.1. User beliefs

The results suggest that the patient-side user beliefs and presumptions can hamper efficient task performance. The users are not always committed to efficient chat e-consultation, which delays efficient information exchange and weakens the productivity of nurse and physician work.

> N8: "[Regarding some ailments] making the ATN, symptom, diagnosis and care plan deduction are easier via phone… You get the response from the customer quicker."

While this could also relate to inefficient user capabilities such as inadequate technological or verbal skills, the results suggest that user beliefs and presumptions towards chat as a medium boost the asynchronicity and not the technologic capabilities alone.

> N9: "[Chat improves the efficiency and productivity of my work] partly, but only partly because I have noticed that many things could be faster via phone… Many things are slower via chat because the person there thinks and may do many other things at the same time. Even some simple cases may take surprisingly long. In that sense, it has not increased the productivity of my work."

> N10: " Customers are often chatting during their work shifts… If the customer is in a situation where he/she does many things at the same time, I have noticed, that it slows down the process if you have to wait for the responses."

As discussed earlier in Section 4.2.3 the synchronism task requirement is not constant throughout the e-consultation. The process phases, such as reserving an appointment or gathering the information, require more synchronous information exchange, and thus during

these process phases, it seems that the potential absence of the patient is highlighted. Moreover, the results suggest that this absence is seen somewhat controversial since the users are expecting fast service via chat, although these expectations are probably related to pre-chat queuing times. The absence of the patient and therefore patient-side low commitment to support synchronous information exchange was seen as a significant factor decreasing the efficiency of e-consultation.

There are pro-efficient user beliefs as well. Based on the interview results, the patients associate chat communication with more compact messaging relating mostly to the core subject of the conversations which naturally positively affects task performance.

> P7: "The patients are able to present their current problem well. In chat conversations, there is no chit-chatting in the beginning, instead, they [patients] immediately present their problems"
>
> N9: "Via phone it [the conversation] bounces a lot more. In chat, you can hold it better together. Via phone, they may start to tell you anything and the [off-topic] speak does not stop.

4.3.2. General capabilities

Medical staff

The interview results suggest that the elicitation and overall written communication skills are highlighted. More specifically the ability to ask not only the right questions regarding the diagnoses or ATN but in the right way is acknowledged and underlined by managers, PCR, physicians, and nurses. Based on the interview results it could not be determined to which degree these skill requirements are currently fulfilled but some respondents felt that the orientation period and material could focus more on these written verbal skills since they are at the core of this information exchange.

Naturally, the technological skills of the medical staff were seen important since all communication is conducted virtually. In this virtual setting, the medical staff must resolve technological problems that they encounter during the chat, and failing to do so may even end up in losing the entire e-consultation session. User-capability-related technological challenges are not entirely caused by chat per se but rather raise from running multiple programs such as EHR, chat platform, and other task-related programs at the same time.

N8: “This [virtual] job requires much more technologic skills when compared to in-person appointments: which kind of programs are used and how the compatibility of the programs affects the efficiency. If the programs freezes then you should know how to solve it.”

Moreover, the technology skill requirements were seen more demanding in video consultations.

Patients

Based on the interview results it is not possible to determine whether some of the patient side challenges are due to skills or simply lack of commitment regarding efficient chat e-consultation. Regardless of the root cause, it seems that the patient side textual input and capability to produce information takes time and severely harms the perceived efficiency.

P5: “The writing speed of the patient is clearly the biggest [delaying] thing… I am not sure what they are doing there… it is very slow on their side”

P6: ”It is definitely the [patient side] typing. After all, it is not at the level of a fast conversation at all… The canned messages that everyone has made definitely help the physician side, but the typing on the patient side is as slow as it is. That is a slowing factor by itself.”

Slow patient response times combined with occasional technologic challenges influence the perceived efficiency of chat e-consultations. According to an interviewee, the slow patient response times have such a severe impact on productivity that the nurses have discussed a possibility to set an upper limit to the duration of the chat. While other factors may have some counterarguments to such limit setting, the existence of such conversations hints of the importance regarding the concern.

N9: ”When the patient does not always respond immediately, you can see that he/she is typing and typing and typing there… and sometimes there are some technical issues and suddenly the customer disappears from the chat and you have waited for a response to some easy question for five minutes, then I start to think that if I had called the patient, it would have been a lot quicker”

A physician (P5) hinted that regarding the efficient task performance there is a fundamental difference in patient skill and commitment requirements in chat when comparing to in-person appointments. According to the physician, during in-person appointments the

patients are roughly as fast in advancing the conversation which is not the case in chat. Whereas for some patients it may take five minutes and with similar conditions for some patients it may take over half an hour. This complicates comparing chat e-consultation to in-person consultations in terms of efficiency.

Despite the challenges in slow responses, generally, the ability of the patient to present their concerns in chat was seen good. It seems that the medical staff is taking a more active role in the conversation and thus the conversation seem more *elicitation*-driven. This will be discussed also in Section 4.4.2 but it is an important observation also regarding patient skills and especially regarding the *presentation* skills of the patient since these results suggest that the presentation skills are less demanding in chat.

> P7: ”Yes sure, they [patients] can present the relevant information well, but we must of course be able to ask the relevant questions”

One physician (P6) estimated that roughly four-fifths of the patients can either start the conversation efficiently and informatively even with their first message or catch up with the physician-driven flow during the consultation after a couple of questions asked by the physician. The remaining one-fifth of the conversations were seen as very hard and where even the high compensatory skills of the medical staff were not seen sufficient to fill the void thus decreasing the perceived efficiency of the chat.

One concrete example of low patient presentation capability was that they often do not answer all of the questions presented by the medical staff. The medical staff uses canned messages that may often include multiple questions in the same message. The incapability of the patients to answer all of these questions may require the medical staff to ask the same questions again and separately. This naturally slows down the e-consultation and diminishes the benefits of canned messages and chat benefits overall.

> P5: “When asked by the chatbot, the patients answer questions rather vaguely and even to my questions… if I have a canned message where there are five questions… almost no one answers all of my questions. The majority answers only partially and then I have to ask the questions again… The capability of the patients to present their concerns while guided [by the medical staff] are rather good but the capability to present their concerns on their own initiative is quite weak.”

N10: ” It slows down the process if the customer disregards the question and it happens a lot. If I, for example, ask whether or not you [the patient] have these symptoms and the customer responds only partly… the customer does not answer to all of the questions or at least as clearly as would be required in order put the information to the medical record without any additional questions asked”

4.4. Technology

In the following two sections the moderating effects of the technology will be discussed (see the conceptual framework in Section 2.5). First, the focus is on the interaction between the technology and the task requirements. Second, the compensatory interaction between the user and the technology will be examined.

4.4.1. Technology and task requirements

Moderating effect on Sensory requirement

Chat offers limited sensory information. When comparing to phone e-consultations, chat lacks auditory information and when compared to video e-consultations chat lacks auditory information and offers only limited visual information. The limited sensory information is transmitted via textual input and photos of the symptoms. Again, drawing on the different dimensions of *representation* as discussed in Section 2.3.3, the relevant representation capabilities in this context are embodied in physical evaluations and communication cues in information exchange.

The physicians and the nurses share the information with the patients via textual output, photos, and links. These are regarded as different symbol sets that affect the synchronous information exchange thus, they will be discussed in greater detail later in Sections 4.2.3 and 4.4.2. However, in this section, they are discussed from their ability to share or *represent* sensory information that is needed to fulfill the sensory requirement of the task. Naturally in the chat environment, the main form of communication is textual which does not support sharing sensory information well. Thus, the representation capabilities of the technology are inherently low in chat.

The interviews show that given the limited sensory information, the physicians and the nurses balance whether the available sensory information is enough to support the right diagnosis or treatment or whether further in-person examinations are needed. Moreover, the

results suggest that they are not willing to sacrifice the quality of the diagnosis or ATN in the name of chat efficiency by handling the case entirely via chat.

> P7: ”[In chat] sometimes I wonder, did I take everything important into account, those more complicated things…perhaps the quality would be enhanced if the patient were on face-to-face appointment…[in chat] those gestures and facial expressions are not there, it is much harder to read between the lines. In the face-to-face appointment, I may have a gut feeling that there is something more than you [the patient] are telling.”

> N10: ”When comparing to in-person appointments, it sometimes is more challenging to do the assessment of treatment need. For instance, one [nurse] might more easily guide to video or in-person appointments if there is any doubt that via chat or phone I cannot rule out the need for in-person or video appointment when I can’t see the rash or the limb or whatever the symptom is.”

Finding this balance is crucial and not succeeding in it may either dilute the purpose and benefits of the chat or have some severe consequences by sacrificing diagnostic confidentiality.

> P6: ”…another important thing to understand is when to treat the patient in chat and when to guide to brick-and-mortar. If you are very insecure and you guide everything to brick-and-mortar, the whole idea of chat vanishes. If you go with a mindset that ‘I will treat every person [entirely] virtually, then things will go terribly wrong. You have to find that balance.”

Nurses and physicians highly value the photos they may receive from the patients regarding their symptoms. Medical staff overall feel that these contribute positively to both the quality and efficiency of the e-consultation.

> N8: “…of course the possibility of the customer being able to take photos and add them to the chat platform, it usually speeds up the ATN… but it [the efficiency of chat] depends on the symptoms the customer has, for instance in wound treatment chat is more efficient [than phone]. Where imaging is needed, the photo can tell a lot more than the customer. Then it is more efficient in chat.”

Moreover, the form and quality of visual information delivered matter. In some situations, such as those including psychological elements and assessment, the gestures and reading between the lines are seen important and thus video tops text and photos. But when the

patient has for instance rash, other dermatological symptoms, or for instance eye-related symptoms where the symptom is visible and distinct, the photo may even be better than video.

> P5: "[When comparing to video e-consultations] you should be extremely careful with the video quality. In principle, the video and audio feed must be essentially understood as a way of communication. Not as a diagnostic tool per se, at least in any specific systems… if you want to demonstrate how the shoulder moves, then you can see it well there [in the video] and the quality is adequate. If we start to look at some rash or lumps, then [the video quality] is not enough"

Clearly, the possibility of adding photos increases the diagnostic confidentiality and makes the chat more suitable for telehealth e-consultations in terms of both efficiency and quality than what chat would be without the photo option.

> P6: "Regarding certain symptoms, you just have to be careful so that you can exclude the severe symptoms… and for instance in eye-related symptoms, just ask for a photo. You just have to, so that you can see that for instance there is no redness suggesting a more severe situation…"

In fact, multiple interviewees pointed out that the photos sent by patients via chat enhance the treatment process as a whole, even when comparing to in-person consultations. Transferring the photos from the chat platform to Electronic Health Record (EHR) was seen easy and convenient. Of course, once added to EHR they are always available for future treatments also. In in-person appointments, no such convenient way of getting pictures to EHR exists.

In summary, in chat, the physicians and the nurses have to adapt to the available representation capabilities consisting of textual output and photos. The results suggest that textual communication has its shortcomings, but some benefits as well. Chat with its technology inherently suffers from lower representation capabilities when compared to in-person appointments. In the case setting, this limitation is more evident for the physicians that are used to in-person appointments. Nurses, however, who are used to phone-mediated consultations have to sacrifice auditorial information enabled by phone but in exchange, they get visual information from photos. As such this swap does not inevitably mean decreased e-consultation efficiency, rather, it moves the spectrum of ailments that are best suitable in that specific channel. The shortcomings include the lack of rich communication that would

be needed in sharing the sensory information. In this regard, and regarding the research question, the textual output even with photos included, decreases the perceived efficiency of chat e-consultations.

Moderating effect on Trust and Relationship requirement

Although the interviewees did not see trust and relationship building as a major obstacle regarding efficiency, they recognized multiple differences when comparing to in-person, video, or phone-mediated consultations. The representation capabilities of the technology have a pivotal role in these changes.

> P7: "You just have to trust what the patient is telling. It is a lot harder to question the textual input from the patient… Another important thing is that how you can phrase your comments in a manner that shows you really care about the patient. It is much more difficult when you cannot tap on the shoulder and encourage the patient "
>
> N8: "One thing that has lifted its head multiple times [during orientation]: how can I really tell the patient with text that I feel bad that he/she has become ill, when [in chat] tone, gestures and facial expressions are missing. Sure, you can write it also but it [textual expression] does not come naturally for all"

The platform used enables presenting a picture, name, and title of the physician or the nurse. Such information is assumed to add trust and humanness between the medical staff and the patient. However, it seems that not all have seen this information important.

> P6: "Here [in chat] the interaction is via the platform… it all begins with having good pictures [of physicians] and concordant and clear titles. It may have been a mess sometimes [regarding some individuals]: without a picture, with a name and at the end, there is some ERL [abbreviation of a specialist in Finnish]. The patients have not even had an idea who they are chatting with."

Conversely, in some cases, the lack of visual information may even be beneficial regarding trust and relationship building. This is naturally seen as a strength of the chat.

> N8: "I think that the patients are more easily contacting via chat, at least the younger generation. There is a lower threshold to sign in there [chat] than even phone. For instance, in the case of rash in the genital area or something similar, that can be very sensitive or unpleasant subject, it may be easier to approach a nurse via chat than via phone."

N10: “For others, it is easier to talk about some sensitive subject when you cannot see [the other participant]”

A physician pointed out also that the relationship that in the in-person setting can be formed between the patient and the physician is challenged in the current chat process. This is due to the patient not being able to choose the physician that he/she is willing to talk to, instead, the patient logs in to the chat and starts it not knowing to whom of the physicians the chat is going to be guided to. Hence, the relationship starts virtually from zero every time the patient starts the chat, which highlights the need for consistent and concordance profile representation of the physicians and the nurses in terms of the profile picture, name, and title.

Furthermore, the long-lasting relationships between the patient and the medical staff are challenged also due to another technological capability: *reach*. Thanks to the reach that IT-enabled Process Virtualization allows, the patients and the medical staff are logging in to the chat e-consultations from all across Finland. Hence, the likelihood of confronting a familiar physician or nurse is significantly decreased when comparing to areal, in-person consultations.

Moderating effect on Synchronism requirement

The lowered synchronism stems from the chat technology that enables the respondent to process the information at a different time than when the sender sends it. In this section, the technological capabilities are discussed with respect to the e-consultation task requirements. Again, it should be remembered that the technology capabilities are not the sole factor regarding the task performance, since the user beliefs and capabilities have a major impact as well. The Media Synchronicity Theory elements will be used to deepen the understanding of technology capabilities supporting synchronous information exchange. Hence, synchronism in this section is understood in a wider perspective that includes all relevant task and technology-related factors in chat e-consultations that contribute to the synchronous information exchange and therefore more efficient task performance.

The results suggest that especially changes in symbol sets, parallelism, and rehearsability play an important role. User beliefs and common practices regarding chat as a communication channel were discussed in Section 4.3.1 and the compensatory user

capabilities regarding these changes in synchronic information exchange will be discussed later in Section 4.4.2.

In chat, both the physicians and the nurses can exchange information with the patient via textual conversation, photos, and links. The value of the photos was more closely discussed in Section 4.2.1 since the photos are used majorly to fulfill the sensory requirement in information gathering and more specifically in physical evaluations.

The main type of information exchange in the chat is naturally textual conversation. While the textual conversation may have some benefits, as will be discussed later, often it is not the most suitable form for rapid and accurate information exchange that is needed during diagnosing or assessing the treatment need (ATN).

> P6: "If there is a more complicated situation and we have the conversation in textual form and we exclude many things [regarding the diagnosis], the chat conversations can be over half an hour long. Then the efficiency is gone and it would have been better in [in-person] appointment."

Regarding the expert consultation process phases (see Figure 1) it seems that the textual form of communication slows down the information gathering.

> P5: "…due to limited physical evaluations that can be done in chat, it is true that information gathering is the one that takes most of the time."

In the appointment reservation phase where the synchronism requirement is highlighted, the chat incapability to support high synchronous information exchange is culminated. All nurse interviewees argued that this significantly decreases the efficiency of chat e-consultations.

> N8: "Reserving an appointment [for the customer] is extremely slow in chat. That is the first stumbling block where the efficiency of the chat consultation is decreased…Reserving slots based on textual conversation and typing is very slow. It is also possible that we must make a longer appointment for the customer [that requires two consecutive slots] and before you receive the response on whether or not the slot is suitable for the customer, the other slot has already been reserved [by someone else]"
>
> N9: "It [reserving the appointment] would always be faster via phone"
>
> N10: " Some things may be slower in chat [than via phone], for instance reserving appointments with many options that you try to offer for the customer"

Although the fundamental reason for the patient's inadequate response time can also stem from the user beliefs towards chat conversation and thus varying synchronism expectations and requirements, the purely technological solutions to compensate this exists, and thus this varying synchronous requirement is in addition to Sections 4.2.3. and 4.4.2 presented here.

The textual form, however, is not limited to user-written messages. Especially the nurses seem to exploit the possibility of sharing links such as home care instructions and tables such as price lists with customers, which improves the efficiency of chat consultation. Despite being in textual form, this could be interpreted as a widened *symbol set* that is not available for instance in phone-mediated conversations or in-person consultations. The reason why the links enable more efficient information exchange and thus is that the medical staff can avoid retyping pre-existing information to the chat conversation. By sharing links, they leave the information processing part on patients' shoulders and thus outside the chat conversation. This is closely related to the benefits of canned messages and overall *rehearsability*, but with the distinction that what happens during or before the conversation and what happens after the consultations.

Along with the aforementioned *symbol sets* also *parallelism* and *rehearsability* played a significant role from the perspective of the technology capability to support synchronicity. Chat as a communication channel increases parallelism which in this context means the possibility of having multiple chat consultations simultaneously ongoing. This indeed was seen very valuable by the respondents and naturally as a boost in terms of chat e-consultation efficiency and general productivity of the work.

> P6: "Having multiple chats at the same time is a whole new ballgame… it makes it [e-consultations] significantly more efficient"

While originally in MST rehearsability describes how the user edits and polishes the message before sending it thus decreasing the synchronicity, in this context canned and prewritten messages are brought to the mix since chat conversations enable writing some messages even before the chat and then using these messages thus saving typing time. While this possibility is embodied as canned messages and used by medical staff, a somewhat similar opportunity applies also to the patients with their first message. The interview results focused on the user actions with which they not only try to adapt to but also reap the benefits of the chat e-consultations. Regarding the efficient task performance, the technologic capabilities in terms of parallelism and rehearsability are inseparable from their usage and

thus they are more thoroughly discussed in the following Section 4.4.2 from the compensatory capability perspective.

Table 4 and Table 5 gather the results regarding the technology capabilities. Since these tables only cover the technology capabilities, they do not cover the whole spectrum of factors impacting the perceived efficiency of chat e-consultations. On the one hand, the users can compensate some of the shortcomings of technology capabilities with their compensatory capabilities, thus the sum effect of these is not presented in these tables. On the other hand, the technology capabilities that increase perceived efficiency are not sufficient on their own but require user capabilities to unleash their potential. However, the line drawn here is blurry, patient writing time for instance does not belong to technology capabilities but is presented here to emphasize the lack of support for synchronicity that indeed is technology capability related. Moreover, these tables do not provide the entire set of factors identified from the technology capability point of view, rather they emphasize the factors with the most significant differences affecting perceived efficiency between the consultation forms, that is between chat and in-person consultations (Table 4) and between chat and phone e-consultations (Table 5). To clarify, the nurses did perceive a plethora of contracts decreasing efficiency, but since this factor enabled by telehealth technology reach capabilities were seen decreasing perceived efficiency in both, chat and phone, this factor is not presented in Table 5.

		Technology capabilities		
		Synchronicity	Representation	Reach
Physicians: chat vs. face to face	Increasing perceived efficiency	Canned messages (physician), prewritten messages (patient), parallel conversations and multitasking		
	Decreasing perceived efficiency	Patient writing time, message editing	Sensory information with image only	Plethora of instructions and contracts

Table 4. Chat technology capabilities impacting perceived efficiency, comparison to face-to-face consultations

		Technology capabilities		
		Synchronicity	Representation	Reach
Nurses: chat vs. phone	Increasing perceived efficiency	Canned messages (nurse), prewritten messages (patient), widened symbolset with photos and links, parallel conversations and multitasking		
	Decreasing perceived efficiency	Patient writing and idle time	Sensory information with image only, no audio	Plethora of instructions

Table 5. Chat technology capabilities impacting perceived efficiency, comparison to phone e-consultations

4.4.2. Technology and user: compensatory interaction

The interaction between the technology and the user differs from the interaction between the technology and the task requirements. The results suggest that the user with his / her compensatory capabilities try to adapt to the setting created by the task and technology environment.

Working in a virtual technological environment setting where representation capabilities are inherently low means that user capabilities must compensate this low representation with their task-specific compensatory skills. In other words, the challenges caused by limited visual and auditorial information must be overcome by user actions in order to successfully accomplish the task of treating the patient. Indeed, the results suggest that users adapt to this low representation environment either consciously or somewhat subconsciously. The major impacts on the e-consultation in this regard is the highlighted role of elicitation skills of medical staff and the presentation skills and speed of the patients. As such, these capabilities of elicitation and presentation are built-in to the task of doctor-patient or nurse-patient consultations itself and thus are not new, but the virtual environment - with its low representation capabilities and changed symbol sets - requires both participant sides to adapt to a new form of communication.

P5: “The physician must guide the conversation more actively in a way. If you are passive and you don’t ask many things from the patient, the patient is not going to tell you a lot. This is very hard to compare [to in-person consultation] since in Finland there are hardly any recordings of [in-person] physician appointments. The conversations have not been studied”

N9: ” Sure, you can use something for feeling the pain like ‘how much does your pain hurt on a scale from 1 to 10.’ or something like this ask there… Yes, you can treat things well in the chat. It just requires that the nurse is able to ask the questions right in the chat. In a similar manner perhaps than via phone, but still, it is different when it's written”

N10: “If you have a calm manner of speaking on phone… you will have to transfer that into text in chat… occasionally it takes some time to format your message clear and neat for the customer…verbal skills, tactfulness, and the capability to rule out [diseases] are highlighted… Also, you will have to [re]ask more specific questions.”

Overall, the communication skills of the patients in terms of their capability to present the task-relevant information to the medical staff were seen good as mentioned earlier. The interviews were conducted on the medical staff side only, and the interviewees seemed to feel a strong responsibility in succeeding in the task by compensating with their own elicitation skills not only the low representation capabilities of the technology but the plausible deficiencies in patient presentation skills as well. Per se, this compensatory effect between physician and patient or between nurse and patient is probably not only present in chat but rather stems from the roles in doctor-patient or nurse-patient consultation and thus happen also in in-person communication. However, this is noteworthy since according to the interview results, on one hand, the medical staff's role in leading the conversation is highlighted and on the other hand, it is seen more difficult due to the mainly textual form of communication.

P7: ”You will have to pick the relevant information from the patient’s message. However, you should not settle for very curt answers. If you feel that this is not enough, then you will have to form your questions in the right way so that you get your patient to tell the things you need for the diagnosis and the care plan.”

The results show that the efficiency of the conversation in this low representation context is highly patient and symptom dependent and thus the communications even with high

compensatory communication skills of a physician or a nurse are not always enough to reach the efficient task performance and unrestricted communication flow, which results usually in inefficient data gathering phase (see Figure 1).

> N8: ”Data gathering takes time. How extensively you will have to ask questions of course depends on the symptoms…You can’t combine three symptoms into one [question], instead, you will have to ask more rigorously about different things so that you get your information gathered.”

> P6: ”Maybe when the gestures are missing… it [the conversation with the patient] can be very stiff with those [patients] that don’t understand your question… it is very patient-specific. It is very hard for some patients, perhaps in those situations the physician could somehow communicate even better. Personally, I have not figured out how…They [the patients] may be elderly or others that are not fluent in fast messaging.”

As chat as a medium is more suitable for some ailments over others, efficient and effective chat usage within the care pathway comes down to two factors: 1) patients contacting with chat-friendly ailments and 2) if the patients come to chat with less chat-optimal ailments, the compensatory skills of the physician or nurse to make the chat consultation useful still. Based on the results the former can be further diffused to two factors: active guidance and experience. On the first hand, for instance, the patients can be instructed even before the chat by informing which ailments the chat is the most useful for and which ailments are better to treat and assess in-person. On the other hand, as chat becomes more familiar as a treatment channel over time, the patients gain more experience and thus make a better evaluation on chat fit regarding the symptom they are having.

> P6: “Those [patients] who have learned how to use chat, they have also learned what kind of ailments can be treated there. Many are not there for the first time, and they know what the name of the game is… Very rarely the expectations are not met.”

The latter, the compensatory skills of the physician or the nurse to make most of the chat, is fruitful when the perspective is widened to the entire care pathway. Consider, for instance, an acute injury, sprained ankle, the chat consultation may not be adequate regarding the treatment but may produce valuable information relevant for the future steps of the treatment.

P5: “If I do good anamneses also in these situations, it is possible to determine the urgency of the care, the place for future treatment, and other things like that. The treatment can be guided with greater quality also in these situations where it is known that an [in-person] appointment is needed... Then also, the goal is not to resolve the whole case there [in chat]”

The trust and relationship-building-related issues were not seen as obstacles in terms of efficiency but working with a channel with low representation requires medical staff to continuously compensate the missing gestures and their virtual presence in their text. Formatting the messages politely yet not too formally was seen crucial in building rapport and trust. The virtual presence in the chat is inherently lowered when comparing to video or phone mediated conversations for instance. This virtual presence, established practices, and beliefs associated with it in chat are inseparable from all three task requirements: synchronism, sensory, and relationship/trust requirement. The orientation material for the medical staff highlighted this virtual presence by instructing physicians and nurses to actively comment and thank for the responses given by patients as well as clearly informing the patients on what the physicians or nurses are about to do next. This seemed to be assimilated well by the medical staff.

P7: ”Almost always I write things like ‘just a moment, I will take a look on your patient record’ and pick some [specific] things ‘oh, you have tried this medication… I cannot find [information] that you would have visited a physiotherapist already’. I want to express that I have sincerely put my mind to her concerns…that I have acquainted myself with her information and that her concerns are the most important thing to me right now.”

N9: “You have to always remember to write things like ‘just a moment, I will take a look at your contract’, remember to write something there [about the actions] so that the customer knows that there is a real human being on the other side of the chat. This is after all a nurse chat and that is why I would not like it being too clinical. This is not some customer service chat…”

The interview results suggest that both, the medical staff and the patient can compensate the lowered synchronicity with their actions and with the help of some tools provided by the chat platform. These compensatory actions presented in this section are partly coupled with the Media Synchronicity Theory capabilities; *parallelism, rehearsability,* and

reprocessability. In this section, the focus is not on judging whether these capabilities have a net effect of either decreasing or increasing the efficiency, rather the focus is on the compensatory perspective. More specifically, the focus is on how do both participant sides of the e-consultation try to reap the benefits of the chat conversation technology capabilities regarding support for synchronicity and thus counterweight its challenges.

Asynchronous conversation and the lag caused by it can be compensated to minimize their effects on efficiency. The challenges caused by mainly textual information exchange, discussed in Section 4.4.2, challenges due to lack of user absence and general beliefs towards chat conversations discussed in Section 4.3.1, and the challenges due to user capabilities discussed in Section 4.3.2 together result in physician or nurse waiting for the patient to respond. The results show that the physicians and the nurses are able to reduce the inefficiency caused by this waiting by having multiple parallel chat conversations (parallelism) or multitasking for instance by starting to fill the medical records in EHR already during the chat. In addition, the participants of the conversation may, although in a bit different manner, exploit the benefits of *rehearsability* and textual form of conversation with prewritten messages.

Based on the interview results the most widely utilized and one of the most important compensatory tools were canned messages or as the respondents call them 'phrases'. The physicians and the nurses have the possibility to use canned messages to their advantage. These canned messages are prewritten messages that the user may use by typing a keyword and then selecting the prewritten 'phrase' associated with that specific keyword. Hence, instead of writing the whole message every time again, the medical staff may make most of the repetition between different chat conversations and the textual form of communication. Since these canned messages are usually formed based on the experience of earlier conversations and can be edited before sending, they could be interpreted as a benefit of rehearsability even though at the moment of their usage, the benefit stems from the reusability of textual format. According to the interviewees, the canned messages are not only useful but a necessity in efficient chat e-consultations.

> P5: "Yes of course [I use canned messages], they are the key in this. You must have those, also longer phrases… Those make it insanely faster and there is no sense [doing chat e-consultations] without them. They are the lifeblood of this."

The interview results suggested that naturally the canned messages are most often used in e-consultation phases where repetitive message patterns occur. One might expect that these sorts of canned messages are useful at session initiation and when closing the session since these are often repetitive. Indeed, the results find proof for this, but they also suggest that as the experience of the physicians and nurses increases, they can exploit the canned messages nearly throughout the e-consultation process.

> N8: "Yes I do use those when there is a lot of repetition. For instance, home care instructions are roughly the same for all, so it is a lot easier to type them with a phrase [canned message]. In addition, of course, greetings and some basic information questions. For example, anamnesis information about basic health, daily medications, or allergies, so that you don't have to write them every time. That is efficiency at its best."

> N10: " …Now during this Corona time, we have to interview [patients] quite extensively, if you don't have those canned messages ready, then it would not perhaps be faster in chat when compared to the phone."

Not every respondent, however, felt using canned messages pleasant. One physician (P7) revealed that she has started to use the canned messages only recently and that earlier typed every message "conscientiously" manually. One nurse respondent (N9) agreed on using canned messages but only in very limited situations such as in greetings. The respondent felt that often the canned messages are not perfectly suitable as-is, but need editing before sending, which may result in taking more time than just writing the message manually.

The canned messages do not solely support the efficiency of e-consultations, but some respondents argue that they may increase the quality as well.

> P6: "[when sensory information is limited] you will just have to play it very safe and ask many questions. If you would have to type everything manually, I have noticed that it makes you lazy. It helps that you have good phrases that are thought through beforehand."

> PCR4: "If you have phrases, they are usually longer because it is easy to use them. If you type manually, you get many typing errors, and the text is a bit clumsy and short when you try to be quick."

While there have been some efforts in the case company to share some useful canned messages for medical staff, based on the results the medical staff is forming their own phrases that suit their personality but also support the gained experience on previous chat conversations.

The medical staff is able to compensate the low synchronicity by having multiple parallel chats. The canned messages seem to truly increase the efficiency when the medical staff is typing their message. However, as the results presented earlier suggest, the patient's answers often have to be waited for and the usage of canned messages falls short as a compensatory action in this respect. Physician and nurse side chat parallelism, having multiple chats at the same time, is a compensatory interaction between the technology and the medical staff as they are balancing the inefficiency caused by the slow answering speed by the patient.

> P5: "Some [of the patients] are so painfully slow that it [chat conversation] takes about half an hour. We could pinch roughly 20 minutes from that. However, we can dodge that with the help of our big [demand] volumes by putting this slow writer aside to write at their own pace meanwhile we take care of other customers. Even though some may think that this is a safety risk for the patient, it really is not."

Chat parallelism together with canned messages distinguish chat from other e-consultation mediums and thus require finding balance in these new capabilities. In other words, as phone and video consultations, that have existed longer in the case company, do not support multiple parallel conversations within the medium, there is a need to adjust to this new capability. Naturally, this parallelism should not be exploited to a degree where patient safety is at risk. In addition to patient safety, the customer experience can be harmed if the medical staff takes too many simultaneous chat conversations. The respondents were unanimous with the reasonable amount of parallel chat conversations as most agreed that two to three parallel chats are suitable for compensating the slow responses while still maintaining quality and patient safety.

> P6: "The sweet spot is from two to three… the typing by patients is so much slower that those you can handle without endangering patient safety or their experience at all. In fact, you answer them just as quick."

Closely related to parallelism is the support for multitasking. Again, the technology capabilities and the task requirements set certain boundaries for multitasking opportunities but the user capabilities to exploit these opportunities seem to drive the actualized

compensatory effects regarding efficient task accomplishment. Given the lower synchronicity requirements in chat e-consultation, the medical staff seems to make most of it in two ways. First, they can advance the e-consultation by doing some of the supporting tasks that are done outside the actual conversation with the patient. These include registering information to EHR and prepare invoicing information for instance.

> P5: "… when the patient leaves the room [after in-person appointment], then you start to make those [entries to EHR]… in chat, if you have a slow patient, then you may have done all of those in advance already. When he/she quits the chat, you click and take the next one. So those [phases] are a bit overlapping also."

Second, they may compensate lower synchronicity requirement or benefit from it by searching information regarding Current Care Guidelines or contacting colleagues. Although such activities are not immediately linked to efficiency, they undoubtedly influence positively e-consultation quality and learning and seem to raise from the lower synchronicity requirement.

> N10: "During chat e-consultation, you can call a colleague. You cannot do this during phone or in-person consultations. Also, the orientation is much easier when you can share your screen and treat the patient together. It is definitely a major advantage"

However, the chat multitasking abilities are harmed due to the textual form of communication that often happens on a separate computer program. An interviewee pointed out that during the phone e-consultations the nurses are able to communicate with the patient better while reading their Occupational Health Contract. Thus, one could question whether the chat literally supports multitasking or should it be interpreted as fulfilling the gaps in between patient responses. The interview results were not able to dig deeper into this, but the results supported the finding that the medical staff found also benefits of lower chat synchronicity.

The interview results identified one more compensatory action by the medical staff to answer the synchronism challenges. This action tried to answer compensate the challenge caused by the changed synchronicity requirement that changes in between different e-consultation process phases, for instance when moving to reserve a further appointment for the patient. In this transition, some of the respondents suggested that after asking the patient for permission to do so, the medical staff changed the medium from chat to phone by calling the

patient. While this is not unproblematic, it emphasizes the difference between the synchronism requirements of phone and chat conversations.

Patients are also able to compensate or utilize the chat technology capabilities to proactively enhance the e-consultation efficiency. Interview respondents revealed that sometimes patients have written long messages before the actual conversation and then copy and paste this prewritten message to the conversation when needed. According to the interview results, these are supporting the efficiency of e-consultation.

> P6: ”Some [patients] have clearly written the message already for their mobile notebook. The chat is efficient when the patient has had a great opening and then with a couple of additional questions [from the physician] we can wrap it up under 10 minutes and everything is done.”
>
> N9: ” If you have to write a sick leave or something like that and the patient has written [the message] well… told about the symptoms and things like that, then the conversations may go quite smoothly. If you have to ask many questions, then it gets slower.”

Prewritten messages by the patients are seen pro-efficient according to the results but the results also suggest that the ailment and the quality of the prewritten seem to determine to which degree these messages can enhance the efficiency. Naturally, when the ailments require a more thorough examination to determine the diagnosis, the presentation and compensatory skills of the medical staff start to play a bigger role.

The interview results did not identify other major patient-side compensatory capabilities that would enhance the efficiency of e-consultations. Furthermore, these same capabilities of chat media technology usually are, at least from Media Synchronicity Theory perspective, seen lowering the synchronicity and indeed do so in a sense. For instance, if the patient is exploiting the rehearsability of chat medium to a degree where he/she types and edits the message for long before sending, it naturally decreases the efficiency. Given the research question and the definition of chat efficiency in this thesis, the focus is on the medical staff's behalf and that is why for instance the parallel chat usage may decrease the inefficiency from the patient point of view, but increase the efficiency in physician or nurse point of view.

In IT-enabled process virtualizations reach has a significant role as a moderating construct and telehealth chat e-consultations make no exception in this regard. Reach capabilities of

the technology brings benefits but may reveal some new challenges as well. On one hand, the reach enables medical staff to treat much larger patient mass by matching the demand and supply more effectively when compared to in-person appointments. Moreover, as the reach increases with this sort of low threshold service, the patient mass may increase even further. Interviewees felt that this increases dramatically the productivity of their work. Naturally, increasing the patient mass does not automatically result in more productive work if the entire process is less efficient than the in-person one. Hence, in their judgement, the interviewees either narrow down the scope of their judgement to cover only their individual perspective where they hoard more patients from others, or the chat e-consultation with its subtasks do increase the e-consultation process in total. Regarding the reach, on the other hand, the interview results suggest that reach brings also major challenges due to nationwide inconsistencies in procedures, occupational health contracts, and other exceptions. Since *reach* enables virtual e-consultations to be conducted nationwide and in e-consultations, the medical staff often need to guide the patient for future treatment, the widened perception of processes regarding brick-and-mortar units all across Finland is put to the test. This seems to create a large set of rules that makes the e-consultation much more difficult and decreases its efficiency.

> P5: "… It is incredibly complicating to master this chat as a whole because we treat the whole Finnish nation. There is no locality. It would require a vast familiarity [to handle] all operation models of all units, systems, and [occupational health] companies, like invoicing codes and other exceptions…Colleagues have difficulties in mastering these and understandably so because there is a plethora of instructions."
>
> M3: "… When operating in [brick and mortar] unit, you become familiar with the areas major contracts, and you can handle those… but now when they [the patients] come all around the country, the nurse or the physician operating on the other side of Finland is not familiar with this local greatness…it brings the complexity [of different contracts] to those simple individual chat e-consultations".

This raises its head also when training the medical staff to provide chat services in addition to their current in-person services. One manager (M2) pointed out that when trying to adapt to chat e-consultations those nurses who are operating majorly with patients in-person perceive these changes regarding the nationwide reach challenging and new. Although these are challenges are not fundamentally caused by chat nor even virtuality, the virtuality with

its reach capabilities reveals possible inconsistencies in case company procedures when examined on a national level.

Partly due to these inconstancies the instructions given to the medical staff have grown to a level where the plethora of instructions together with their constant changes may even influence the efficiency of the e-consultation if followed punctually.

> P7: "The instructions change all the time… if you take every instruction conscientiously, it does hamper the efficiency…[cites another physician] ' if you do everything punctually by the instructions, you may finish a couple of chats per hour…'"

The reach and the vast patient mass with it put the professional competence of the physician and the nurse to the test from the medical perspective as well. The interview results suggest that especially physicians encounter ailments on a widened spectrum. This highlights certain capabilities and may even affect task efficiency.

> P6: "…comprehensive management of the overall situation [is needed]. You don't have to be an expert on everything but when the volume is immense, questions will arise from here and there. If you cannot handle them straight away, then it [the e-consultation] stalls."

5. Discussion

This chapter provides a summary of the empirical results and reflects them to prior research findings. The results are categorized according to the conceptual framework similarly to Chapter 4. Summarized results answer the research question of *How does the perceived efficiency of chat e-consultations differ from other consultation forms and why*. At the end of the chapter, a brief section will be presented to cover the other factors that fell outside the conceptual framework.

Efficient performance

The results in this study suggest that measuring efficiency in e-consultations is challenging. Especially the results from manager interviews called for more holistic measures on efficiency that would seize the total impact of chat e-consultations on the entire care path. This is in line with Cady and Finkelstein (2013) as they point out that efficiency in video-

mediated triage is lost when only looking at nurse triage, but when zooming out to the whole critical pathway the results are unclear.

Task requirements

The sensory requirement exists in primary care e-consultations according to the results of this study. However, the results suggest that the sensory requirement varies according to the ailment of the patient as the amount and type of sensory information (e.g. auditory and visual) needed for the treatment changes. This is also acknowledged by Serrano and Karahanna (2016). The technology capabilities mediating this requirement are discussed below.

Regarding the trust and relationship requirement, the results of this case study suggest that the requirement is a relevant requirement to be studied in e-consultations. According to the interviewees, however, there were no changes caused by chat that would impact perceived efficiency significantly when comparing to other e-consultation forms. The results in this study suggest that trust and relationship requirement is a product of other factors or requirements thus differing from the conceptual framework. Though, even if some of these other factors, such as lower synchronicity, were identified the results did not support harmed perceived efficiency in the name of unreached trust and relationship requirement. The results may have been different if the chat services selected for the study would have been different. For instance, Dowling and Rickwood (2015) suggest that in mental health chat services the trust and relationship building is in a central role and thus the general practice chat services included in this study were not fully comparable. The results hinted that inherent or built-in trust created by strong identification (patient side) and trust towards the company (physician and nurse side) may have affected trust-building, but these results were preliminary. This could provide a topic for future research and is closely related to identity and control requirements in PVT by Overby (2008).

Next, looking at the synchronism requirement of the task, the results suggest that changes in synchronism requirement separate chat from other e-consultation forms such as video or phone. One important finding from the results was that the synchronism requirement is not constant throughout the e-consultation. For instance, when appointments must be reserved for the patient during the chat, more synchronous information exchange is needed and thus the synchronism requirement is increased. The interview results suggest that despite

synchronism requirement being lowered in chat e-consultations, synchronism is needed to achieve efficient task performance.

User

The results on user beliefs suggest that chat conversations are associated with lower synchronism. Thus, even if the technology itself would be able to support close to synchronous information exchange, the results of this study suggest that patient-side assumptions and lack of commitment in efficient task performance slow down the e-consultations significantly. In the light of the results presented in this study, these factors cause users being often idle during chat conversations. These appropriation factors such as earlier experience with the medium are also included in MST by Dennis, Fuller and Valacich (2008). The lack of commitment in efficient task accomplishment is somewhat controversial since according to the results the users are also expecting fast service via chat. However, the results suggest that not all user beliefs are anti-efficient since chat communication is also associated with less need for off-topic conversation and small talk. This more direct conversation in the chat is also found by Gieselmann *et al.* (2021).

The results gathered relevant user capabilities that enable efficient task performance. Verbal elicitation and technology-related skills were identified by the interviewees as the most important user capabilities regarding the medical staff. As the communication is via text, the elicitation skills of the nurse or the physician are especially highlighted. Regarding the patient, presentation capabilities were highlighted in the results. These presentation capabilities found mixed results. On one hand, the general capability of the patients to present relevant information, including adding photos, was seen good. On the other hand, the results revealed that patients may disregard some questions and often lack the capability to proactively present relevant information. The results suggested that these accompanied by the slow typing speed of the patient significantly decrease the efficiency. The results are in line with Serrano and Karahanna (2016) as they emphasize the importance of medical staff elicitation skills and patient presentation skills in a low representation setting.

Technology

Next, focusing on the mediating role of the technology on the task requirements, the results in this study suggest that regarding the sensory requirement chat e-consultation performance is more case-specific with limited representation capabilities. The results of this study found that due to limited representation capabilities in this IT-enabled virtualized process, only

visual cues are available in chat e-consultations and even these are limited to photos, hence challenging sensory requirement fulfillment. However, the findings from Serrano and Karahanna (2016) suggest that the representation capability alone does not determine the task performance but the compensatory user and IT interactions discussed later in this section, affect the outcome as well. The medical staff in this case study have text, photos, and links at their disposal regarding information exchange and out of these, the first two were used by the physician and nurse interviewees to gather the relevant sensory information that would be acquired with a full spectrum of sensory cues in in-person appointments. The interviewees in this study found the ability to add photos to the conversation widening the set of feasible ailments that can be efficiently treated with chat. The results of this study suggest that the limited representation capabilities of the technology decrease the perceived efficiency since the compensatory actions need to be taken with textual communication which does not fully support rapid back-and-forth information exchange. However, due to interviewed physicians and nurses being not willing to sacrifice the quality of the treatment in the case of inadequate sensory information, the results suggest that the lack of sensory information impacts more on the number of treatable ailments in chat rather than its perceived efficiency. The reasoning behind this is that in the case of inadequate sensory information, the patient seems to be quite rapidly guided to in-person consultation for further examination according to the results.

Regarding the mediating role of technology on trust and relationship requirements, the results in this study suggest that some technology capabilities hamper rapport building. More specifically, interviewed physicians and nurses felt that the textual form of communication, reach, and limited representation capabilities of the technology complicate the trust and relationship-building activities. However, they also estimated that the low representation capabilities of the technology can also be beneficial in some situations lowering the threshold for patients starting chat e-consultations regarding some sensitive topics for instance. Gieselmann *et al.* (2021) found that many patients feel the opposite.

When examining the technology capabilities and their mediating role on synchronism requirement, the results presented in this study find available symbol sets and rehearsability as the most important technologic capabilities affecting perceived efficiency. As mentioned, the earlier text, photos, and links can be used in information exchange in the case of this study. These case study results suggest that textual communication does not support rapid

information exchange and thus it decreases the perceived efficiency. Considering chat capabilities this limited symbol set and its negative impact on synchronicity is in line with MST (Dennis, Fuller and Valacich, 2008). The possibility to share links was seen as pro-efficient and speeding up the e-consultation by the interviewed nurses, even when compared to in-person appointments. Rehearsability enabled by chat technology is embodied in this case context as the possibility to edit the messages before sending them and the results suggest that this ability may harm the perceived efficiency. Probably the closest medium to be compared with the chat in Dennis, Fuller and Valacich (2008) is synchronous instant messaging (see Table 2) that has either medium or high rehearsability and reprocessability capabilities. Hence the results regarding rehearsability in this research are not surprising. Interpreting the rehearsability more broadly enables to examine some pro-efficient features used by the case study medical staff. These features are canned and prewritten messages. Accepting this broader interpretation of rehearsability reveals that even if the rehearsability may according to MST by Dennis, Fuller and Valacich (2008) impact negatively to Media Synchronicity, the results in this study suggest that in some situations this increased rehearsability may prove to be pro-efficient regarding the communication and task performance, hence in line with Randall (2011). Moreover, according to the results in this study, the synchronism requirement varies throughout the different e-consultation phases, and changing the medium was sometimes used to cover the lack of chat technology capability to support synchronicity. This change of medium that supports the new requirements of the communication is in line with the recommendations by MST (Dennis, Fuller and Valacich, 2008).

Synchronous communication, synchronicity, and task performance seem to have a particularly interesting relationship as suggested by the results of this study. As MST suggests, synchronous communication is needed to achieve synchronicity (Dennis, Fuller and Valacich, 2008) but synchronous messaging is not solely enough. The results of this study show that in some cases e-consultations need back-and-forth communication where rapid messaging would be appreciated, hence synchronicity would seem a valuable target. However, as soon as anti-efficient appropriation factors, such as anti-efficient user beliefs, are introduced the results of this study suggest that the lower media synchronicity may affect positively task efficiency via parallel chats for instance. In such situations, parallelism should naturally be used only to the extent to cover the initial inefficiencies caused by the

anti-efficient appropriation factors. The results from Randall (2011) support this favorable impact of parallelism on task efficiency.

User and technology compensatory interactions form a key factor regarding the e-consultation efficiency according to the results presented in this study. The importance of these compensatory capabilities is in line with the findings by Serrano and Karahanna (2016). More specifically the results in this case study find user compensatory capabilities highly important. The key role of the user in effective system use is acknowledged in Burton-Jones and Grange (2013). The results in this study suggest that the users try to compensate the possible inefficiencies and challenges caused by changes in e-consultation requirements, limitations of the technology, or deficiencies of the other participant's capabilities with their compensatory capabilities. Hence, the conceptual framework used in this thesis does not fully capture the compensatory interactions between the users and the technology. This lack of support from the conceptual framework is due to it highlighting the mediating role of the technology between the user and the task performance while the results in this study suggest specifically the user compensatory capabilities.

According to the results of this study, the medical staff takes a more active role in guiding the conversation with detailed questions to balance the lower representation capabilities of the technology. Moreover, the medical staff interviewed in this study has to continuously assess whether the available information is sufficient for determining the diagnosis or the further treatment. Such compensatory capabilities had a significant role in Serrano and Karahanna's (2016) research in terms of e-consultation diagnosticity, but earlier literature does not provide examples from compensatory user capabilities in terms of e-consultation efficiency. Results in this study also suggest that the medical staff can start parallel chat conversations or do some of the e-consultation subtasks in advance while waiting for the patient's answer in order to compensate the inefficiencies caused by changes in synchronicity and slow responses by the patients. Furthermore, the interviews in this study found that the nurses and the physicians are able to use canned messages to speed up their textual output. According to the results, parallel chat conversations, multitasking, and canned messages have a major compensatory and thus positive impact on efficient task performance. The interviews in this study identified that the patients may also compensate the changes in synchronism by using prewritten messages that enable the patient to rehearse their message even before the actual conversation. Hence, the compensatory user capabilities

are not used solely to compensate lower representation capabilities of the technology, as found significant in Serrano and Karahanna (2016), but to compensate lower synchronicity as well.

The results in this study suggest that reach is a key factor that has both positive and negative mediating effects on the overall efficiency. Although the interviewees in this study concluded that reach enables enormous flexibility and saves total time especially from the patient perspective, the results reveal that medical staff capabilities are challenged. According to the results, the lack of locality brings a multitude of instructions and contracts to be familiarized, which understandably decreases the efficiency as the case company medical staff must constantly discover new information from unfamiliar occupational health contracts and do multiple check-ups for the everchanging instructions.
In addition, the results suggest that the reach capabilities of the technology put the pervasive professional medical capabilities of the medical staff to the test as the spectrum of the cases increases.

6. Conclusions

Regarding the research question, this thesis has found that the perceived efficiency of chat e-consultations varies highly according to the ailment and its diagnostic complexity, beliefs, and capabilities of the user, especially those of the patient. The amount of variety brought by these factors separates chat from other e-consultation forms in terms of perceived efficiency.

Due to limited representation capabilities of the technology and thus limited sensory information, not all ailments can be entirely treated with chat. Furthermore, due to user beliefs combined with reduced chat technology capabilities to support synchronicity caused by the textual form of communication, for instance, the perceived efficiency of chat e-consultations is decreased. However, with the technology capabilities together with compensatory user capabilities, the participants are able to counterweight the impacts. The medical staff can take a more active role in guiding the conversation and thus put their elicitation skills to the test. They can benefit from chat parallelism and canned messages thereby increasing the efficiency. The patients may also compensate the lag from the textual conversation by rehearsing and prewriting their message to be sent even before the actual chat.

To conclude, the results suggest that the efficiency of chat e-consultations may top other consultations forms when the ailment is a simple and usual case that does not require sensory information beyond textual or photo representation and when both participants are committed to close to synchronous messaging. However, as soon as conversations lengthen, the ailment requires rich sensory information, or either of the participants respond with a delay, the perceived efficiency decreases below face-to-face, video, or phone consultations.

Implications to practice

This thesis has provided insight to practitioners by shedding light on the factors contributing to chat e-consultations perceived efficiency. This has been achieved by first, identifying current challenges that chat e-consultations bring in the telehealth context. These challenges have not only been presented but dug a bit deeper to get to the source of the issue. Second, by gathering the opportunities enabled by chat as a medium, the thesis has emphasized that chat e-consultations can outperform other consultation forms in terms of efficiency when the conditions and actions are right. These compensatory actions cocreated by technology and user compensatory capabilities have been discussed in detail. Third, by offering concrete recommendations for the organizations the thesis has bundled the challenges and opportunities together, therefore, contributing to chat e-consultation service production also in the future.

The findings from this thesis information are important not only for the case company but for the healthcare sector organizations in general and the rapid growth of chat services fuels the need. As the chat e-consultations and other services become more and more popular and the patient mass consuming chat services expands, it becomes increasingly important to identify the current challenges and benefits of the chat. In addition to a volume-driven motivation to find inefficiencies, the findings become important due to the possible spread of chat services across different actors within the healthcare sector. Hence, the results may not be important only for the case company but, when keeping the limitations of the study in mind, for other health care organizations as well. Furthermore, to some degree the findings may prove to be beneficial for other than healthcare organizations providing chat services as well since not all findings are tightly tied to the healthcare context.

To conclude, by identifying challenges and opportunities brought by chat as a low-threshold e-consultation form this thesis offers valuable insight for providing telehealth services that

enable improved access for patients thereby increasing the number of patients to be treated and ultimately enhancing universal health coverage.

The challenges and the opportunities that emerged from the research yielded the following Table 6 that gathers the recommendations. The recommendations are primarily aimed at the case company but to some extent, they are generalizable for other organizations offering chat e-consultation as well.

Theme	Factor / Sub theme	Recommendation
Lower representation	Trust building	Enhance visual representation of medical staff profile: profile picture, name, title are coherent
	Elicitacion and textual communication	Be wary of using multiple simultaneous questions
		Encourage to ask detailed questions
		Remind the importance of photos from patients
	Chat fit	Support medical staff to find the balance on what can be treated via chat
		Inform patients actively about the chat limitations
Lower synchronism	Symbol sets	Encourage link usage
		Examine possibility for private links for patients in appointment reservation
	Synchronism requirement change	Support changing medium, to phone for instance, when synchronism requirement changes
	Rehearsability: canned messages	Encourage sharing of pro-efficient canned messages to other medical staff members
		Enable easy ediiting
		Encourage canned message usage during orientation
	Parallel chats	Clarify the instructions on parallel chats
		Highlight the need for experience in both medium and the task before encouraging parallel chats
	Multitasking	Ensure patient messages alert if chat software on a separate window
		Focus on this during orientation, sicne smaller risk than in parallel chats
		Reap the benefits of this during orientation via screen sharing for instance
Other	Reach	Clarify the overwhelming instruction set

Table 6. Recommendations

Implications to research

The thesis brings value also regarding the research in the field of IS and Telehealth. It provides an empirical Case Study that extends telehealth e-consultation literature with a rather novel medium used in this context. Since the literature regarding chat usage in e-consultations is scarce and regarding synchronous chat usage in telehealth outside the mental health clinical area is limited, the findings provide valuable insight for the research fields. The empirical study that lays the foundations of its conceptual framework on three popular IS theories enables multiple contact surfaces to develop future research. The thesis used Process Virtualization Theory (Overby, 2008) to identify relevant requirements and some

IT-capabilities regarding IT-enabled virtualized processes, Task Technology Fit (Goodhue and Thompson, 1995) to combine user, task, technology and to interpret their total impact on perceived task performance and finally Media Synchronicity Theory (Dennis, Fuller and Valacich, 2008) to deepen the understanding of the technology capabilities since the technology is what ultimately separates the consultation forms from each other. PVT and TTF theories have been used together earlier (see Section 2.5. for references), but there were no papers found in this context that would have used MST together with PVT and TTF in their research model. The conceptual framework was well supported by the results presented in this thesis, which contributes to research in this telehealth context by offering a valuable conceptual framework to be used.

Limitations

This thesis comes with limitations that define the generalizability of the results. The main limitations in this regard are due to scoping and methodology.

Using three IS theories to form the conceptual framework implies that some relevant parts of the theories had to be scoped out to focus on answering the core research question. Some factors such as differences in chat reimbursement for medical staff and overall service production differences between the physicians and nurses may play a pivotal role in the absolute efficiency of chat e-consultations, but these were scoped out to protect case company professional secrecy and due to lack of overall fit regarding the theoretical approach. Although the theories used are partially fulfilling each other some factors were not included in the study. For instance, when examining the Media Synchronicity capabilities in this dyadic expert consultation, the patient viewpoint should be analyzed more thoroughly to gain more comprehensive results. Also, the identification and control requirements were scoped out from the study, and thus explanatory power from a Process Virtualization Theory main construct could not be covered. The third theoretical scoping limitation comes from the interpretation of Fit in Task-Technology-Fit. Even though the thesis did this by following some examples from existing literature, the undefined role of fit in impacting the efficiency in the empirical part of this thesis leaves the concept of fit vague. Moreover, although Goodhue and Thompson (1995) propose using TTF as ‘the basis for a strong diagnostic tool’, Lending and Straub (1997) argue TTF model may fall short in this perspective.

There are a couple of limitations regarding the empirical data collection as well. First of all, the case study was conducted with a very limited number of interviews. With three managers, one PCR, three physicians, and three nurses, the variety of perspectives to be tackled might have impacted the depth of the research results.

With such limitations, the generalization of the results in this thesis is done deliberately with caution.

Suggestions for future research

This thesis paved the way for identifying the factors that separate chat e-consultations from other consultation forms and especially how those factors contribute to perceived efficiency. The findings gather relevant factors, but future research could deepen the understanding and possibly quantify the impacts that identified factors emerged in this thesis have on efficiency measures. Gathering empirical data via observations or chat e-consultation transcripts could provide more quantitative approaches.

The telehealth literature calls for systematic literature reviews of chat usage in the medical domain. The literature and practitioners would also benefit from a more comprehensive approach to e-consultation efficiency that would examine the total efficiency and effectiveness of the entire patient care path and thus analyze the true effects that such e-consultation forms have. The future research could in addition focus on gathering chat possibilities across clinical areas and outside medical staff-patient consultations thereby helping to reach the full potential of chat services. Now when the e-consultation is isolated it is assumed that the total effects cannot be entirely understood. Bridging this gap could be started by first approaching the issue also from the patient side as many papers in this topic focus on the producer side.

References

Ali, S. B., Romero, J., Morrison, K., Hafeez, B. and Ancker, J. S. (2018) 'Focus Section Health IT Usability: Applying a Task-Technology Fit Model to Adapt an Electronic Patient Portal for Patient Work', *Applied Clinical Informatics*, 9(1), pp. 174–184. doi: 10.1055/s-0038-1632396.

Almathami, H. K. Y., Than Win, K. and Vlahu-Gjorgievska, E. (2020) 'Barriers and facilitators that influence telemedicine-based, real-time, online consultation at patients' homes: Systematic literature review', *Journal of Medical Internet Research*, 22(2). doi: 10.2196/16407.

Balci, B., Grgecic, D. and Rosenkranz, C. (2013) 'Why people reject or use virtual processes: A test of process virtualization theory', *19th Americas Conference on Information Systems, AMCIS 2013 - Hyperconnected World: Anything, Anywhere, Anytime*, 5, pp. 4009–4016.

Barth, M. and Veit, D. (2011) 'Which Processes Do Users Not Want Online? - Extending Process Virtualization', in *International Conference on Information Systems 2011, ICIS 2011*, pp. 1040–1060.

Bensink, M., Hailey, D. and Wootton, R. (2006) 'A systematic review of successes and failures in home telehealth: preliminary results', *Journal of Telemedicine and Telecare*, 12(SUPPL. 3), pp. 8–16. doi: 10.1258/135763307783247121.

Bensink, M., Hailey, D. and Wootton, R. (2007) 'A systematic review of successes and failures in home telehealth. Part 2: Final quality rating results', *Journal of Telemedicine and Telecare*, 13(SUPPL. 3), pp. 10–14. doi: 10.1258/135763307783247121.

Bestsennyy, O., Gilbert, G., Harris, A. and Rost, J. (2021) *Telehealth: A quarter-trillion-dollar post-COVID-19 reality?*, *McKinsey & Company*. Available at: https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality (Accessed: 7 November 2021).

Brant, H., Atherton, H., Ziebland, S., McKinstry, B., Campbell, J. L. and Salisbury, C. (2016) 'Using alternatives to face-to-face consultations: A survey of prevalence and attitudes in general practice', *British Journal of General Practice*, 66(648), pp. e460–e466. doi: 10.3399/bjgp16X685597.

Burton-Jones, A. and Grange, C. (2013) 'From use to effective use: A representation theory perspective', *Information Systems Research*, 24(3), pp. 632–658. doi: 10.1287/isre.1120.0444.

Byron, K. (2008) 'Carrying Too Heavy a Load? The Communication and Miscommunication of Emotion by Email', *Academy of Management Review*, 33(2), pp. 309–327.

Cady, R. G. and Finkelstein, S. M. (2013) 'Mixed-methods approach for measuring the impact of video telehealth on outpatient clinic triage nurse workflow', *CIN - Computers*

Informatics Nursing, 31(9), pp. 439–449. doi: 10.1097/01.NCN.0000432126.99644.6c.

Cady, R. G. and Finkelstein, S. M. (2014) 'Task-technology fit of video telehealth for nurses in an outpatient clinic setting', *Telemedicine and e-Health*, 20(7), pp. 633–639. doi: 10.1089/tmj.2013.0242.

Cane, S. and McCarthy, R. (2009) 'Analyzing the factors that affect information systems use: A task-technology fit meta-analysis', *Journal of Computer Information Systems*, 50(1), pp. 108–123. doi: 10.1080/08874417.2009.11645368.

Czarnecki, C., Winkelmann, A. and Spiliopoulou, M. (2010) 'Services in electronic telecommunication markets: A framework for planning the virtualization of processes', *Electronic Markets*, 20(3–4), pp. 197–207. doi: 10.1007/s12525-010-0045-8.

Daft, R. L. and Lengel, R. H. (1986) 'Organizational Information Requirements, Media Richness and Structural Design', *Management Science*, 32(5), pp. 554–571.

Dennis, A., Fuller, R. M. and Valacich, J. S. (2008) 'Media, Tasks and Communication Processes: a Theory of Media Synchronicity', *MIS Quarterly*, 32(3), pp. 575–600.

Dorsey, E. R. and Topol, E. J. (2016) 'State of Telehealth', *New England Journal of Medicine*, 375(2), pp. 154–161. doi: 10.1056/nejmra1601705.

Dowling, M. and Rickwood, D. (2015) 'Investigating individual online synchronous chat counselling processes and treatment outcomes for young people', *Advances in Mental Health*, 12(3), pp. 216–224. doi: 10.1080/18374905.2014.11081899.

Edison, K., Ward, D., Dyer, J., Lane, W., Chance, L. and Hicks, L. (2008) 'Diagnosis, diagnostic confidence, and management concordance in live-interactive and store-and-forward teledermatology compared to in-person examination', *Telemedicine and e-Health*, 14(9), pp. 889–895.

Eminovic, N., Wyatt, J. C., Tarpey, A. M., Murray, G. and Ingrams, G. J. (2004) 'First evaluation of the NHS Direct Online Clinical Enquiry Service: A nurse-led Web chat triage service for the public', *Journal of Medical Internet Research*, 6(2). doi: 10.2196/jmir.6.2.e17.

Fera, B., Shah, U., Korba, C. and Shukla, M. (2021) *Virtual health accelerated*, *Deloitte*. Available at: https://www2.deloitte.com/us/en/insights/industry/health-care/virtual-health-accelerated.html/ (Accessed: 11 July 2021).

Fiol, C. M. and O'Connor, E. J. (2005) 'Identification in Face-to-Face, Hybrid, and pure virtual teams: Untangling the contradictions', *Organization Science*, 16(1), pp. 19–32. doi: 10.1287/orsc.1040.0101.

Fortney, J. C., Burgess, J. F., Bosworth, H. B., Booth, B. M. and Kaboli, P. J. (2011) 'A re-conceptualization of access for 21st century healthcare.', *Journal of general internal medicine*, 26 Suppl 2, pp. 639–647. doi: 10.1007/s11606-011-1806-6.

Gieselmann, A., Podleschka, C., Rozental, A. and Pietrowsky, R. (2021) 'Communication Formats and Their Impact on Patient Perception and Working Mechanisms: A Mixed-

Methods Study of Chat-Based vs. Face-to-Face Psychotherapy for Insomnia', *Behavior Therapy*, 52(2), pp. 430–441. doi: 10.1016/j.beth.2020.06.001.

Gieselmann, A. and Pietrowsky, R. (2019) 'The effects of brief chat-based and face-to-face psychotherapy for insomnia: a randomized waiting list controlled trial', *Sleep Medicine*, 61, pp. 63–72. doi: 10.1016/j.sleep.2019.03.024.

Gill, P., Stewart, K., Treasure, E. and Chadwick, B. (2008) 'Methods of data collection in qualitative research: Interviews and focus groups', *British Dental Journal*, 204(6), pp. 291–295. doi: 10.1038/bdj.2008.192.

Goodhue, D. L., Klein, B. D. and March, S. T. (2000) 'User evaluations of IS as surrogates for objective performance', *Information and Management*, 38(2), pp. 87–101. doi: 10.1016/S0378-7206(00)00057-4.

Goodhue, D. L. and Thompson, R. L. (1995) 'Task-Technology Fit and Individual Performance', *MIS Quarterly: Management Information Systems*, 19(2), pp. 213–233. doi: 10.2307/249689.

Hu, P. J., Chau, P. Y. K., Liu Sheng, O. R. and Tam, K. Y. (1999) 'Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology', *Journal of Management Information Systems*, 16(2), pp. 91–112. doi: 10.1080/07421222.1999.11518247.

King, N. and Brooks, J. (2018) 'Thematic Analysis in Organisational Research', in *The SAGE Handbook of Qualitative Business and Management Research Methods: Methods and Challenges*. 1 Oliver's Yard, 55 City Road London EC1Y 1SP: SAGE Publications Ltd, pp. 219–236. doi: 10.4135/9781526430236.n14.

Lam, C. (2016) 'Improving Technical Communication Group Projects: An Experimental Study of Media Synchronicity Theory Training on Communication Outcomes', *Journal of Business and Technical Communication*, 30(1), pp. 85–112. doi: 10.1177/1050651915602293.

Lehoux, P., Sicotte, C., Denis, J. L., Berg, M. and Lacroix, A. (2002) 'The theory of use behind telemedicine: How compatible with physicians' clinical routines?', *Social Science and Medicine*, 54(6), pp. 889–904. doi: 10.1016/S0277-9536(01)00063-6.

Lending, D. and Straub, D. W. (1997) 'Impacts of an integrated information center on faculty end-users: A qualitative assessment', *Journal of the American Society for Information Science*, 48(5), pp. 466–471. doi: 10.1002/(SICI)1097-4571(199705)48:5<466::AID-ASI12>3.0.CO;2-X.

Li, X., Rai, A. and Ganapathy, K. (2020) 'Designing cost-effective telemedicine camps for underprivileged individuals in less developed countries: A decomposed affordance-effectivity framework', *Journal of the Association for Information Systems*, 21(5), pp. 1279–1312. doi: 10.17705/1jais.00637.

Mallen, M. J., Jenkins, I. M., Vogel, D. L. and Day, S. X. (2011) 'Online counselling: An initial examination of the process in a synchronous chat environment', *Counselling and Psychotherapy Research*, 11(3), pp. 220–227. doi: 10.1080/14733145.2010.486865.

Mburu, S. and Oboko, R. (2018) 'A model for predicting utilization of mHealth interventions in low-resource settings: case of maternal and newborn care in Kenya', *BMC Medical Informatics and Decision Making*, 18(1), pp. 1–16. doi: 10.1186/s12911-018-0649-z.

Miranda, S. M. and Saunders, C. S. (2003) 'The Social Construction of Meaning: An Alternative Perspective on Information Sharing', *Information Systems Research*, 14(1), pp. 87–106. doi: 10.1287/isre.14.1.87.14765.

Naik, N. and Kim, D. J. (2010) 'An extended adaptive structuration theory for the determinants and consequences of virtual team success', *ICIS 2010 Proceedings - Thirty First International Conference on Information Systems*.

Niinimäki, T., Piri, A., Lassenius, C. and Paasivaara, M. (2012) 'Reflecting the choice and usage of communication tools in global software development projects with media synchronicity theory', *Journal of Software: Evolution and Process*, 24(6), pp. 677–692. doi: 10.1002/smr.566.

Overby, E. (2008) 'Process virtualization theory and the impact of information technology', *Organization Science*, 19(2), pp. 277–291. doi: 10.1287/orsc.1070.0316.

Overby, E. M. and Konsynski, B. (2008) 'Process Virtualization: A Theme and Theory for the Information Systems Discipline', *SSRN Electronic Journal*. doi: 10.2139/ssrn.1138045.

Overby, E. M. and Konsynski, B. (2010) 'Task-Technology Fit and Process Virtualization Theory: An Integrated Model and Empirical Test', *SSRN Electronic Journal*, (March). doi: 10.2139/ssrn.1567097.

Overby, E., Slaughter, S. A. and Konsynski, B. (2010) 'The design, use, and consequences of virtual processes', *Information Systems Research*, 21(4), pp. 700–710. doi: 10.1287/isre.1100.0319.

Randall, D. P. (2011) 'Ten Red Balloons: Virtual Teams and Online Communities - A Test of Media Synchronicity Theory', *iS Channel*, 6(1), pp. 13–21.

Roine, R., Ohinmaa, A. and Hailey, D. (2001) 'Assessing telemedicine: A systematic review of the literature', *Cmaj*, 165(6), pp. 765–771. doi: 10.1136/bmj.323.7312.557.

Saaranen-Kauppinen, A. and Puusniekka, A. (2006) 'Menetelmäopetuksen tietovaranto KvaliMOTV', *Kvalitatiivisten menetelmien verkko-oppikirja. Yhteiskuntatieteellisen tietoarkiston julkaisuja*, p. 170. Available at: http://www.fsd.uta.fi/menetelmaopetus/.

Scott Kruse, C., Karem, P., Shifflett, K., Vegi, L., Ravi, K. and Brooks, M. (2018) 'Evaluating barriers to adopting telemedicine worldwide: A systematic review', *Journal of Telemedicine and Telecare*, 24(1), pp. 4–12. doi: 10.1177/1357633X16674087.

Serrano, C. I. and Karahanna, E. (2009) 'An Exploratory Study of Patient Acceptance of Walk-in Telemedicine Services for Minor Conditions', *International Journal of Healthcare Information Systems and Informatics*, 4(4), pp. 37–56. doi: 10.4018/jhisi.2009071003.

Serrano, C. and Karahanna, E. (2016) 'The Compensatory Interaction Between User Capabilities And Technology Capabilities In Influencing Task Performance: An Empirical Assessment In Telemedicine Consultations', *MIS Quarterly*, 40(3), pp. 597–621.

Skopp, N. A., Workman, D. E., Adler, J. L. and Gahm, G. A. (2015) 'Analysis of Distance Collaboration Modalities: Alternatives to Meeting Face-to-Face', *International Journal of Human-Computer Interaction*, 31(12), pp. 901–910. doi: 10.1080/10447318.2015.1072786.

Smith, A. C. *et al.* (2020) 'Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19)', *Journal of Telemedicine and Telecare*, 26(5), pp. 309–313. doi: 10.1177/1357633X20916567.

Son, J., Lee, H. K., Jin, S. and Lee, J. (2019) 'Content features of tweets for effective communication during disasters: A media synchronicity theory perspective', *International Journal of Information Management*, 45(October 2017), pp. 56–68. doi: 10.1016/j.ijinfomgt.2018.10.012.

Thomas, M., Costa, D. and Oliveira, T. (2016) 'Assessing the role of IT-enabled process virtualization on green IT adoption', *Information Systems Frontiers*, 18(4), pp. 693–710. doi: 10.1007/s10796-015-9556-3.

Totten, A. M. *et al.* (2016) 'Telehealth: Mapping the Evidence for Patient Outcomes From Systematic Reviews', (26).

Tuckson, R. V, Edmunds, M. and Hodgkins, M. L. (2017) 'Telehealth', *The New England Journal of Medicine*, 377(16), pp. 1585–1593.

United Nations (2019) *World Population Ageing 2019:Highlights*, *Department of Economic and Social Affairs, Population Division (2019)*. Available at: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf.

United States Senate Committee on Finance (2015) 'Bipartisan Chronic Care Working Group Policy Options', (December).

Wang, H., Tao, D., Yu, N. and Qu, X. (2020) 'Understanding consumer acceptance of healthcare wearable devices: An integrated model of UTAUT and TTF', *International Journal of Medical Informatics*, 139(February). doi: 10.1016/j.ijmedinf.2020.104156.

Whitten, P. S., Mair, F. S., Haycox, A., May, C. R., Williams, T. L. and Hellmich, S. (2002) 'Systematic review of cost effectiveness studies of telemedicine interventions', *British Medical Journal*, 324(7351), pp. 1434–1437. doi: 10.1136/bmj.324.7351.1434.

Wootton, A. R., McCuistian, C., Packard, D. A. L., Gruber, V. A. and Saberi, P. (2020) 'Overcoming technological challenges: Lessons learned from a telehealth counseling study', *Telemedicine and e-Health*, 26(10), pp. 1278–1283. doi: 10.1089/tmj.2019.0191.

World Health Organization (2016) *Global diffusion of eHealth: Making universal health coverage achievable.*, *Report of the third global survey on eHealth*. Available at: http://who.int/goe/publications/global_diffusion/en/.

Yin, R. K. (2018) *Case Study Research and Applications - Design and Methods*. 6th edn.

Zigurs, I. and Buckland, B. K. (1998) 'A theory of task/technology fit and group support systems effectiveness', *MIS Quarterly: Management Information Systems*, 22(3), pp. 313–334. doi: 10.2307/249668.

Appendix

Guiding interview questions for physicians and nurses

Background / overall	- What is your background as a physician / nurse and what are the different types of consultations you have experience with? - For how long have you been offering e-consultations? What about chat e-consultations? - Do you feel that offering chat e-consultations improves the efficiency and productivity of your work? - Do you think chat is more efficient than other types of consultations? Why? / in which situations? - Which factors hinder the efficiency of chat e-consultations the most? - How could the efficiency of chat e-consultation be improved? - How do patients position themselves for chat treatments? - What are the strengths of the chat for the patient or the physician / nurse? - Do you perceive chat as important and useful channel for meeting patients / doing your work? - What are the goals set for chat e-consultations? - How would you define efficient e-consultation?
Task	*Trust and relationship* - How do you build trust with the patient? - Is trust-building in chat different from other types of consultations? - Do you perceive trust and relationship building challenging in chat? - What would further facilitate trust and relationship building in chat? *Sensory requirement / representation* - How does chat differ from other consultations in terms of sensory information? - How do you proceed to get the information you need from the patient? - How does the sensory information on chat impact the task outcome? *Synchronicity* - How does chat differ from other consultations regarding its synchronicity? Why? How does it affect efficiency? - Do you do parallel chat e-consultations? Why / Why not? How does parallelism affect efficiency and quality? *Process phases and the nature of the task* - Thinking about the different phases of the e-consultation process, does any part of the process take a particularly long time? Why? Does it apply only to chat or also to other types of consultations? - Are the patients entering the chat consultation for the right reasons?

	- Is there any recurrence between chat conversations for some stage of the process? Why? How could one benefit from it? - How do supporting tasks affect the efficiency of the process? How do they differ from other types of consultations?
Individual capabilities	*Technology-related skills* - Do you perceive the technical skills of the patients as sufficient? - Do you perceive your own and your colleagues' technical skills as sufficient? - What kind of technical problem situations are the most common? *Task-related skills* - How would you describe the patients' ability to present the information you need via chat? - How would you describe your own ability to ask for the information you need via chat? - What skills are emphasized in chat e-consultations on the patient and physician / nurse side?
Technology	- How does the technology used fit to chat e-consultations? - What technology characteristics support / harm e-consultation? - Do you perceive used systems as stable? Are there any differences from other types of consultations? - Do you use "phrases" or canned messages, why / why not? - Can you think of any other functions / tools that chat allows?
Other factors + summary	- How would you develop chat e-consultations? - Are there other factors that affect the efficiency of chat e-consultations? - Do you have any instructions or tips that you would like to share with the patients before they start chatting?